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ABSTRACT

This Occupational Competency Analysis Profile (OCAP) contains a competency list verified by expert workers and developed through a modified DACUM (Developing a Curriculum) involving business, industry, labor, and community agency representatives from Ohio. This OCAP identifies the occupational, academic, and employability skills (competencies) needed to enter horticulture occupations. These 11 units are included: general safety precautions; marketing and sales; merchandise handling; business management; facility maintenance; vehicle and tool maintenance; vehicular equipment operation; floral design; greenhouse plant production; turf and landscape operations; and nursery and garden operations. The units detail the knowledge, skills, and attitudes (competency builders) needed to perform each competency. Within the competency list are two levels of items, core items essential for entry-level employment, and items needed to advance in horticulture occupations. The OCAP guide also contains an academic job profile based on the Work Keys system that identifies the level of applied academic skills that students must master to qualify for and be successful in their occupations; a total list of academic competencies in communication, mathematics, and science that all students should master; and a specific list of academic competencies for horticulture. (YLB)

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ED 388 865

OCAP

OCCUPATIONAL COMPETENCY ANALYSIS PROFILE

HORTICULTURE

U.S. DEPARTMENT OF EDUCATION
Office of Educational Research and Improvement
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Introduction

What is an OCAP?

According to the *Action Plan for Accelerating the Modernization of Vocational Education: Ohio's Future at Work*—

> A comprehensive and verified employer competency list will be developed and kept current for each program
>
> —Imperative 3, Objective 2—

The Occupational Competency Analysis Profiles (OCAPs) are the Ohio Division of Vocational and Adult Education's response to that objective.

OCAPs are competency lists—verified by expert workers—that evolve from a modified DACUM job analysis process involving business, industry, labor, and community agency representatives from throughout Ohio. The OCAP process is directed by the Vocational Instructional Materials Laboratory located at The Ohio State University's Center on Education and Training for Employment.

How is the OCAP used?

Each OCAP identifies the occupational, academic, and employability skills (or competencies) needed to enter a given occupation or occupational area. The OCAP not only lists the *competencies* but also clusters those competencies into broader *units* and details the knowledge, skills, and attitudes (*competency builders*) needed to perform each competency.

Within the competency list are two levels of items: core and advancing. *Core items*, which are essential for entry-level employment, are required to be taught and are the basis for questions on the Ohio Vocational Competency Assessment (OVCA). *Advancing items* (marked with an asterisk) are those needed to advance in a given occupation.

School districts may add as many units, competencies, and/or competency builders as desired to reflect local employment needs, trends, and specialties. Local advisory committees should be actively involved in the identification and verification of additional items. Vocational and applied academic instructors will be able to formulate their courses of study using the varied contents of the OCAP and will be able to monitor competency gains via the new criterion-referenced competency testing program, which is tied to the competencies identified on the OCAP.

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Horticulture OCAP Options

The *Horticulture Occupational Competency Analysis Profile (OCAP)* includes a section of core competencies that is to be taught to all students enrolled in a horticulture program. In addition to the core competencies, select one of the three following options. Each teacher should select the option that coordinates with the program designated in the course of study.

Option 1 Floriculture and Greenhouse Worker

Option 2 Turf and Landscape Worker

Option 3 Nursery and Garden Worker

Occupational Competency Analysis Profile:

Horticulture

Unit 1: General Safety Precautions

Competency 1.1: Maintain safe work environment

Competency Builders:

1.1.1 Follow safety information and updates
1.1.2 Organize the work area
1.1.3 Maintain the work area in a clean and safe condition
1.1.4 Identify hazardous materials
1.1.5 Identify the location of material safety data sheets (MSDSs)
1.1.6 Comply with job site and equipment safety rules
1.1.7 Identify safety devices and the functions of each
1.1.8 Maintain safety devices
1.1.9 Comply with general-use and restricted-use product regulations
1.1.10 Identify nonchemical safety hazards
1.1.11 Report nonchemical safety hazards to designated individual or agency
1.1.12 Correct nonchemical safety hazards
1.1.13 Identify chemical safety hazards*
1.1.14 Report chemical safety hazards to designated individual or agency*
1.1.15 Correct chemical safety hazards*
1.1.16 Document employees' compliance with company regulations regarding controlled-substance use

Competency 1.2: Practice safe work habits

Competency Builders:

1.2.1 Identify the importance of the individual's role in safety
1.2.2 Comply with label information
1.2.3 Wear job-appropriate protective clothing and equipment
1.2.4 Practice safe lifting and carrying methods
1.2.5 Interpret safety-symbol signs
1.2.6 Check working condition of safety equipment and personal protective equipment
1.2.7 Report malfunctioning of safety equipment and personal protective equipment
1.2.8 Recognize symptoms of chemical poisoning
1.2.9 Communicate symptoms of chemical poisoning to designated individual

Competency 1.3: Follow established procedures for the operation and maintenance of vehicular equipment

Competency Builders:

1.3.1 Follow safety rules for equipment operation and maintenance
1.3.2 Interpret safety symbols
1.3.3 Maintain safety shields on equipment
1.3.4 Identify potential equipment safety hazards
1.3.5 Report potential equipment safety hazards to designated individual
1.3.6 Follow manufacturer's service recommendations
1.3.7 Maintain valid operator's license*

Unit 2: Marketing and Sales

Competency 2.1: Maintain company image

Competency Builders:

2.1.1 Explain importance of image
2.1.2 Identify factors affecting image
2.1.3 Exhibit personal hygiene appropriate to work environment
2.1.4 Follow dress code
2.1.5 Follow company policies and procedures (e.g., as outlined in company manual)
2.1.6 Perform work to industry standards
2.1.7 Follow written and oral instructions
2.1.8 Keep equipment clean
2.1.9 Communicate positively with customers

Competency 2.2: Price merchandise

Competency Builders:

2.2.1 Identify factors affecting prices
2.2.2 Identify psychological effects of pricing*
2.2.3 Compare pricing strategies*
2.2.4 Estimate fixed and variable expenses*
2.2.5 Calculate break-even points*
2.2.6 Calculate markups
2.2.7 Determine merchandise pricing based on calculations
2.2.8 Attach price tags
2.2.9 Prepare merchandise for inventory or display

Competency 2.3: Promote products and services in the retail area*

Competency Builders:

2.3.1 Identify products and services to be presented*
2.3.2 Plan promotional presentations*
2.3.3 Prepare promotional materials (e.g., signs, fliers)*
2.3.4 Prepare product demonstrations, exhibits, and displays*
2.3.5 Arrange retail area according to season*

Competency 2.4: Market products and services*

Competency Builders:

2.4.1 Describe key factors in marketing agricultural products*
2.4.2 Identify products and services to be presented*
2.4.3 Locate market information sources*
2.4.4 Identify opportunities for publicity*
2.4.5 Compare types and costs of advertising media*
2.4.6 Identify target markets (i.e., potential buyers)*
2.4.7 Identify distribution channels*

Continued

Competency 2.4: ***Market products and services**—Continued*

2.4.8 Analyze competition*
2.4.9 Develop marketing goals*
2.4.10 Determine when to market*
2.4.11 Prepare advertisements*

Competency 2.5: Perform presale activities

Competency Builders:

2.5.1 Maintain product and service knowledge
2.5.2 Compare the features and benefits of different products
2.5.3 Analyze types of selling techniques
2.5.4 Identify types of customers
2.5.5 Identify customer buying motives

Competency 2.6: Determine customer needs

Competency Builders:

2.6.1 Greet customers in accordance with company protocol
2.6.2 Interpret customers' descriptions of their needs
2.6.3 Identify products available
2.6.4 Estimate quantity of products needed
2.6.5 Estimate total cost of products needed

Competency 2.7: Provide customers with recommendations and technical assistance

Competency Builders:

2.7.1 Use selling technique appropriate to type of customer
2.7.2 Use product demonstrations, exhibits, and displays
2.7.3 Recommend products to meet customers' needs
2.7.4 Provide product information
2.7.5 Interpret product labels
2.7.6 Provide care and safety instructions
2.7.7 Demonstrate product use
2.7.8 Describe extent of product guarantees
2.7.9 Recommend alternate products
2.7.10 Recommend "add-on" items
2.7.11 Describe services
2.7.12 Handle customer objections in accordance with company policy*
2.7.13 Process customer complaints

Competency 2.8: Process sales

Competency Builders:

2.8.1 Process telephone orders
2.8.2 Process tax-exempt sales transactions
2.8.3 Process charge account transactions
2.8.4 Process bank card transactions

Continued

Competency 2.8: ***Process sales****—Continued*

2.8.5 Process cash transactions
2.8.6 Calculate customer discounts
2.8.7 Complete sales forms
2.8.8 Compute sales taxes
2.8.9 Close sales
2.8.10 Process customer refunds
2.8.11 Wrap purchases
2.8.12 Determine when merchandise is to be delivered
2.8.13 Follow up on purchases and sales*

Unit 3: Merchandise Handling

Competency 3.1: Process merchandise received

Competency Builders:

3.1.1 Follow general safety precautions related to merchandise handling
3.1.2 Unload merchandise
3.1.3 Distribute merchandise to designated location for processing
3.1.4 Interpret packing slips and invoices
3.1.5 Check merchandise for shipping discrepancies
3.1.6 Inspect products for damage
3.1.7 Unpack merchandise
3.1.8 Group products according to quality and variety
3.1.9 Handle products according to type
3.1.10 Report discrepancies and damages to designated individual

Competency 3.2: Process merchandise for shipping

Competency Builders:

3.2.1 Follow general safety precautions related to merchandise handling
3.2.2 Comply with government regulations concerning the shipping of agriculture products
3.2.3 Prepare shipping packaging appropriate to product
3.2.4 Control quality in packing merchandise
3.2.5 Verify customer address
3.2.6 Prepare/attach shipping labels/delivery tags
3.2.7 Determine delivery routes
3.2.8 Calculate shipping charges
3.2.9 Record shipments
3.2.10 Process returns to vendors
3.2.11 Load merchandise
3.2.12 Secure loads
3.2.13 Unload products
3.2.14 Collect COD payments

Unit 4: Business Management

Competency 4.1: Perform general office duties

Competency Builders:

4.1.1 Follow general safety precautions related to office operations
4.1.2 Open business facility*
4.1.3 Plan work schedules*
4.1.4 Schedule appointments and meetings
4.1.5 Duplicate materials
4.1.6 File materials
4.1.7 Prepare reports
4.1.8 Process mail*
4.1.9 Prepare correspondence*
4.1.10 Practice telephone etiquette
4.1.11 Send/receive documents via the fax machine
4.1.12 Interpret computer printouts*
4.1.13 Maintain service records
4.1.14 Maintain mailing list
4.1.15 Maintain business records*
4.1.16 Secure business documents*
4.1.17 Perform basic math functions using a calculator
4.1.18 Balance cash drawer
4.1.19 Deposit daily cash receipts*
4.1.20 Close business facility*

Competency 4.2: Manage information using computer applications

Competency Builders:

4.2.1 Identify current horticultural software*
4.2.2 Select computer applications appropriate to business needs*
4.2.3 Identify hardware components and the functions of each
4.2.4 Access computer functions using a keyboard
4.2.5 Access computer functions using a mouse
4.2.6 Save files on selected media storage devices
4.2.7 Print files
4.2.8 Access remote connections using a modem*
4.2.9 Send/receive messages and documents via electronic communication systems*
4.2.10 Download files from a remote source*
4.2.11 Place electronic orders*

Competency 4.3: Control inventory

Competency Builders:

4.3.1 Organize storage area
4.3.2 Conduct physical inventories of merchandise, structures, and equipment
4.3.3 Control inventory using Universal Product Codes (UPCs)*

Continued

Competency 4.3: ***Control inventory****—Continued*

4.3.4 Identify high-activity and low-activity items*
4.3.5 Rotate stock
4.3.6 Update merchandise prices
4.3.7 Identify turnover rate factors*
4.3.8 Report minimum inventory levels needed
4.3.9 Maintain dump records
4.3.10 Organize sales area

Competency 4.4: Conduct general banking procedures*

Competency Builders:

4.4.1 Prepare funds for bank deposit*
4.4.2 Make bank deposits*
4.4.3 Write checks*
4.4.4 Endorse checks*
4.4.5 Balance bank statements*
4.4.6 Process banking transactions via automated teller machines (ATMs)*

Competency 4.5: Maintain customer accounts*

Competency Builders:

4.5.1 Check customer credit reference information*
4.5.2 Verify customer addresses*
4.5.3 Set up customer files*
4.5.4 Manage accounts using computerized coding*
4.5.5 Post customer purchases*
4.5.6 Post customer receipts*
4.5.7 Post accounts payable*
4.5.8 Balance customer accounts*
4.5.9 Prepare customer statements*
4.5.10 Prepare customer invoices*

Competency 4.6: Order merchandise*

Competency Builders:

4.6.1 Assess merchandise seasonality*
4.6.2 Determine what to order*
4.6.3 Determine quantity to order*
4.6.4 Determine when to order*
4.6.5 Select vendors using price lists and catalogs to analyze and compare merchandise*
4.6.6 Secure vendor discounts*
4.6.7 Prepare daily, weekly, and monthly stock orders*
4.6.8 Order replacement parts*
4.6.9 Prepare purchase orders*
4.6.10 Direct computer ordering*
4.6.11 Calculate shipping charges*
4.6.12 Determine amount of storage needed*

Competency 4.7: Manage financial records*

Competency Builders:

4.7.1 Maintain production and sales records*
4.7.2 Analyze production and sales records*
4.7.3 Determine plant production costs*
4.7.4 Prepare budgets*
4.7.5 Prepare financial records*
4.7.6 Maintain financial records*

Option 1: Floriculture and Greenhouse Worker

Unit 5: Facility Maintenance

Competency 5.1: Perform basic greenhouse facility and equipment maintenance tasks

Competency Builders:

5.1.1 Follow general safety precautions related to facility and equipment maintenance
5.1.2 Describe operation of greenhouse equipment requiring basic maintenance
5.1.3 Assemble equipment in accordance with written assembly instructions
5.1.4 Inspect assembled equipment for operating defects
5.1.5 Operate ventilation systems
5.1.6 Clean/lubricate parts
5.1.7 Adjust belts on equipment
5.1.8 Mix gas and oil for a two-cycle engine
5.1.9 Troubleshoot problems
5.1.10 Clean/sanitize facility
5.1.11 Fumigate facility*
5.1.12 Repair plastic covering on greenhouse structure*
5.1.13 Replace damaged sections of saran or black cloth*
5.1.14 Replace damaged support wires for saran or black cloth*

Competency 5.2: Perform major greenhouse facility and equipment maintenance tasks

Competency Builders:

5.2.1 Follow general safety precautions related to facility and equipment maintenance
5.2.2 Describe operation of greenhouse equipment requiring major maintenance
5.2.3 Follow manufacturer's specifications for equipment maintenance
5.2.4 Troubleshoot problems
5.2.5 Hang doors
5.2.6 Repair doors
5.2.7 Construct benches and frames*
5.2.8 Repair benches and frames*

Continued

Competency 5.2: ***Perform major greenhouse facility and equipment maintenance tasks—Continued***

5.2.9 Replace windowpanes*
5.2.10 Shade greenhouse glass*
5.2.11 Install/replace plastic covering on greenhouse structure
5.2.12 Clean heating and cooling systems
5.2.13 Replace greenhouse fans*
5.2.14 Service ventilation systems
5.2.15 Replace ventilation systems*
5.2.16 Design a simple irrigation system*
5.2.17 Install irrigation systems and components*
5.2.18 Repair irrigation systems
5.2.19 Recycle water*
5.2.20 Identify types of pipe, pipe fittings, insulation, and plumbing fixtures*
5.2.21 Cut pipe or tubing (e.g., polyvinyl-chloride [PVC], aluminum)*
5.2.22 Install pipe and pipe fittings*
5.2.23 Install valves and faucets*
5.2.24 Repair valves and faucets*
5.2.25 Maintain filter systems*
5.2.26 Install sprinkler heads and mist heads*
5.2.27 Test sprinkler spray patterns*
5.2.28 Adjust sprinkler spray patterns*
5.2.29 Repair broken pipes, sprinkler heads, mist heads, and valves*
5.2.30 Maintain automatic waterers*

Competency 5.3: Apply protective coatings

Competency Builders:

5.3.1 Follow general safety precautions related to the use of protective coatings
5.3.2 Identify types of coatings
5.3.3 Determine type of coating to be used
5.3.4 Identify application methods
5.3.5 Clean surface manually
5.3.6 Sand surface
5.3.7 Clean surface using steam and high-pressure wash equipment*
5.3.8 Apply masking tape
5.3.9 Mix paint
5.3.10 Thin paint
5.3.11 Apply primer coat
5.3.12 Apply finish coat
5.3.13 Apply wood preservative
5.3.14 Clean equipment

Unit 6: Vehicle and Tool Maintenance

Competency 6.1: Service wheels and tires

Competency Builders:

6.1.1 Follow general safety precautions related to wheel and tire service
6.1.2 Visually inspect tires
6.1.3 Check tire pressure
6.1.4 Inflate tires
6.1.5 Check lug nuts
6.1.6 Tighten loose lug nuts
6.1.7 Replace flat tires

Competency 6.2: Use hand and power tools

Competency Builders:

6.2.1 Follow general safety precautions for the use of hand and power tools
6.2.2 Identify standard tools and the functions of each
6.2.3 Select tools appropriate for given job
6.2.4 Follow operating instructions for hand and power tools
6.2.5 Set up/adjust tools
6.2.6 Clean/lubricate tools
6.2.7 Recondition hand tools
6.2.8 Sharpen tools
6.2.9 Store tools
6.2.10 Report damaged tools
6.2.11 Troubleshoot problems

Unit 7: Vehicular Equipment Operation

Competency 7.1: Perform predeparture functions

Competency Builders:

7.1.1 Follow general safety precautions related to predeparture functions
7.1.2 Maintain service schedule
7.1.3 Select fuel
7.1.4 Refuel power units
7.1.5 Maintain fluids
7.1.6 Clean inside and outside of vehicle
7.1.7 Inspect working condition of lights
7.1.8 Check mirrors
7.1.9 Inspect belts*
7.1.10 Adjust belts*
7.1.11 Visually inspect for leaks
7.1.12 Select oil
7.1.13 Secure all equipment and materials
7.1.14 Flag extended materials
7.1.15 Troubleshoot problems

Competency 7.2: Operate vehicular equipment*

Competency Builders:

7.2.1 Follow general safety precautions related to vehicular equipment operation*
7.2.2 Adjust throttle for operating conditions*
7.2.3 Interpret equipment gauge readings*
7.2.4 Start engine*
7.2.5 Preheat diesels*
7.2.6 Jump-start vehicles*
7.2.7 Adjust seating and steering*
7.2.8 Operate manual transmission*
7.2.9 Operate automatic transmission*
7.2.10 Operate hydrostatic transmission*
7.2.11 Communicate using hand operating signals*
7.2.12 Use brake systems*
7.2.13 Shut down engine*
7.2.14 Secure vehicle when parked*
7.2.15 Set out safety markers*
7.2.16 Operate power take-offs*
7.2.17 Operate winches*
7.2.18 Operate liftgates*
7.2.19 Operate dump beds*
7.2.20 Operate hydraulics*
7.2.21 Operate snowplows*
7.2.22 Operate utility vehicles*
7.2.23 Operate boom trucks (i.e., cherry picker)*

Unit 8: Floral Design

Competency 8.1: Demonstrate knowledge of floral designs and arrangements

Competency Builders:

8.1.1 Demonstrate knowledge of the history of design
8.1.2 Identify principles of design
8.1.3 Identify color principles
8.1.4 Identify design styles
8.1.5 Identify the mechanics of floral arranging
8.1.6 Identify floral tools and commonly used products
8.1.7 Identify techniques for using silk and dry materials
8.1.8 Identify wreath construction techniques

Competency 8.2: Prepare materials for floral arrangements

Competency Builders:

8.2.1 Select style appropriate for occasion
8.2.2 Identify available flowers
8.2.3 Identify available foliage
8.2.4 Select flowers
8.2.5 Select foliage
8.2.6 Select containers
8.2.7 Prepare containers
8.2.8 Select accessories
8.2.9 Prepare accessories
8.2.10 Construct bows
8.2.11 Spray-tint dried and live floral products

Competency 8.3: Construct general-purpose floral arrangements

Competency Builders:

8.3.1 Construct boutonnieres
8.3.2 Construct corsages
8.3.3 Construct hand-tied bouquets*
8.3.4 Construct fruit basket arrangements
8.3.5 Construct asymmetrical arrangements
8.3.6 Construct round arrangements
8.3.7 Construct vertical arrangements
8.3.8 Construct horizontal arrangements
8.3.9 Construct symmetrical arrangements
8.3.10 Construct contemporary arrangements*
8.3.11 Construct hogarth-shaped arrangements*
8.3.12 Construct wreaths
8.3.13 Construct bud vases
8.3.14 Facilitate the construction of floral arrangements using mass production techniques
8.3.15 Package loose cut flowers
8.3.16 Write enclosure cards

Competency 8.4: Provide wedding flowers and services

Competency Builders:

8.4.1 Conduct wedding consultations*
8.4.2 Construct body flowers
8.4.3 Construct round bouquets
8.4.4 Construct arm bouquets
8.4.5 Construct cascade bouquets
8.4.6 Construct crescent bouquets
8.4.7 Construct wedding fans and muffs*
8.4.8 Construct contemporary bouquets*
8.4.9 Set up wedding decorations*
8.4.10 Service wedding arrangements*
8.4.11 Dismantle wedding decorations*

Competency 8.5: Prepare live plant groupings

Competency Builders:

8.5.1 Identify varieties of plants
8.5.2 Select plants
8.5.3 Select containers
8.5.4 Design plant groupings
8.5.5 Construct plant groupings (e.g., dish gardens, planters, European gardens)
8.5.6 Maintain plants
8.5.7 Compost plant and soil debris*
8.5.8 Recycle plastics*

Competency 8.6: Prepare sympathy flowers

Competency Builders:

8.6.1 Construct casket sprays
8.6.2 Construct standing sprays
8.6.3 Construct wreaths
8.6.4 Construct traditional sympathy arrangements
8.6.5 Construct contemporary sympathy arrangements*
8.6.6 Construct set pieces*
8.6.7 Write enclosure cards
8.6.8 Determine funeral home delivery procedures*

Competency 8.7: Care for perishable products in accordance with industry standards (e.g., Chain of Life)

Competency Builders:

8.7.1 Follow general safety precautions related to the care of perishable products
8.7.2 Select products that meet the standards for acceptable quality
8.7.3 Process incoming products according to industry standards
8.7.4 Select storage techniques appropriate for product
8.7.5 Select delivery techniques appropriate for product
8.7.6 Provide consumer information

Unit 9: Greenhouse Plant Production

Competency 9.1: Demonstrate knowledge of plant physiology and growth

Competency Builders:

9.1.1 Differentiate between woody and herbaceous plants
9.1.2 Differentiate between evergreen and deciduous plants
9.1.3 Identify basic plant parts and their functions
9.1.4 Explain the photosynthesis process and its function
9.1.5 Identify the functions of roots, stems, and leaves
9.1.6 Identify the requirements for healthy plant growth
9.1.7 Compare taproot and fibrous root systems
9.1.8 Identify techniques for conserving water

Competency 9.2: Test soil, water, and plant tissues

Competency Builders:

9.2.1 Follow general safety precautions related to the testing of soil, water, and plant tissues
9.2.2 Take soil samples for testing
9.2.3 Take water samples for testing
9.2.4 Collect plant tissues for testing
9.2.5 Interpret soil test results received
9.2.6 Interpret water test results received
9.2.7 Interpret plant tissue test results received*
9.2.8 Determine pH levels
9.2.9 Determine soluble salt levels

Competency 9.3: Prepare media mixes

Competency Builders:

9.3.1 Follow general safety precautions related to the use of media materials
9.3.2 Identify media functions
9.3.3 Shred/mix planting media materials
9.3.4 Identify types of media pasteurization
9.3.5 Pasteurize media*
9.3.6 Select premixed media for purchase

Competency 9.4: Prepare for propagation

Competency Builders:

9.4.1 Follow general safety precautions related to propagation
9.4.2 Identify the plants and cuttings to be propagated
9.4.3 Grade cuttings for size
9.4.4 Interpret seed and bulb tag information
9.4.5 Determine the environmental factors affecting propagation
9.4.6 Select the containers to be used
9.4.7 Select the media to be used
9.4.8 Sanitize propagation equipment, areas, and containers
9.4.9 Determine the number of plants, seeds, or cuttings per container
9.4.10 Determine planting depth
9.4.11 Determine plant scheduling*
9.4.12 Prepare seedbed
9.4.13 Treat bulbs to control fungus*
9.4.14 Scarify difficult seeds with hard seed coats*
9.4.15 Soak difficult seeds*
9.4.16 Facilitate propagation using increased automation*

Competency 9.5: Propagate plants

Competency Builders:

9.5.1 Follow general safety precautions related to propagation
9.5.2 Sow seeds
9.5.3 Plant bulbs

Continued

Competency 9.5: ***Propagate plants—Continued***

9.5.4 Force bulbs
9.5.5 Take cuttings
9.5.6 Plant cuttings
9.5.7 Apply rooting hormones
9.5.8 Plant plugs
9.5.9 Label plants and cuttings
9.5.10 Identify propagation problems*
9.5.11 Identify types of mechanical seeders and components and the functions of each*
9.5.12 Describe tissue culture methods*

Competency 9.6: Care for plants

Competency Builders:

9.6.1 Follow general safety precautions related to plant care
9.6.2 Identify requirements for healthy plant growth
9.6.3 Select material-handling systems*
9.6.4 Label plants or cuttings
9.6.5 Disbud plants
9.6.6 Transplant plants
9.6.7 Space plants
9.6.8 Adjust plant support systems
9.6.9 Pinch plants
9.6.10 Select growth-regulating compounds*
9.6.11 Apply growth-regulating compounds*
9.6.12 Monitor plant growth (i.e., graphical tracking)*
9.6.13 Package cuttings for shipment*
9.6.14 Facilitate plant care using automation*

Competency 9.7: Fertilize plants

Competency Builders:

9.7.1 Follow general safety precautions related to the use of fertilizers
9.7.2 Identify fertilization practices and terminology
9.7.3 Identify types of fertilizers
9.7.4 Identify symptoms of nutrient deficiency
9.7.5 Describe the effects of nitrogen, phosphorus, and potassium on plant growth
9.7.6 Determine kind of fertilizer and soil amendments to apply*
9.7.7 Interpret fertilizer labels
9.7.8 Interpret manufacturer's fertilization-rate charts
9.7.9 Determine amount of fertilizer and lime to apply*
9.7.10 Mix fertilizer solutions*
9.7.11 Apply liquid fertilizers manually
9.7.12 Apply dry fertilizers manually
9.7.13 Calibrate fertilizer application equipment*
9.7.14 Apply fertilizers using a fertilizer injector
9.7.15 Identify symptoms of toxicities*
9.7.16 Identify the short- and long-term impact of fertilizer on people and the environment*

Competency 9.8: Regulate the greenhouse environment

Competency Builders:

9.8.1 Follow general safety precautions related to greenhouse maintenance
9.8.2 Identify factors influencing plant growth
9.8.3 Identify environmental control systems
9.8.4 Install shade cloths
9.8.5 Select shading compounds appropriate for plants to be grown
9.8.6 Select supplemental lighting*
9.8.7 Set timers to regulate lighting*
9.8.8 Interpret light meter readings
9.8.9 Hand-irrigate plants
9.8.10 Adjust irrigation systems*
9.8.11 Adjust cooling systems*
9.8.12 Control humidity*
9.8.13 Adjust temperatures for plants
9.8.14 Measure carbon dioxide levels*

Competency 9.9: Identify plant diseases*

Competency Builders:

9.9.1 Identify disease organism structures*
9.9.2 Differentiate between fungal, viral, and bacterial disorders*
9.9.3 Diagram the fungal process of life*

Competency 9.10: Identify insect pests*

Competency Builders:

9.10.1 Identify major insect orders and examples of each*
9.10.2 Identify the characteristics of no metamorphosis, gradual metamorphosis, and complete metamorphosis*
9.10.3 Differentiate between no metamorphosis, gradual metamorphosis, and complete metamorphosis*
9.10.4 Provide examples of each type of metamorphosis*
9.10.5 Calculate the scope of insect damage in agricultural losses in dollars*

Competency 9.11: Identify weeds

Competency Builders:

9.11.1 Define *weed*
9.11.2 Differentiate between annual, perennial, and biennial weeds
9.11.3 Identify given weeds
9.11.4 Identify types of chemical controls for treating weeds*
9.11.5 Describe the purposes and types of mulch

Competency 9.12: Plan pest-control programs

Competency Builders:

9.12.1 Follow general safety precautions related to the use of pest controls
9.12.2 Identify various types of pest damage
9.12.3 Estimate pest population numbers*
9.12.4 Assess degree of damage*
9.12.5 Identify treatments for plant diseases*
9.12.6 Differentiate between preemergent and postemergent weed treatments
9.12.7 Identify chemical/cultural/biological control options*
9.12.8 Select biological controls whenever possible*
9.12.9 Interpret chemical labels and compatibility charts
9.12.10 Categorize pesticides according to controlling action (e.g., stomach, contact, systemic)*
9.12.11 Prescribe program of treatment for a specific greenhouse crop*
9.12.12 Complete certification requirements for prescribed chemical applications*

Competency 9.13: Apply chemical treatments*

Competency Builders:

9.13.1 Follow general safety precautions related to the use of chemicals*
9.13.2 Calibrate application equipment*
9.13.3 Mix chemicals*
9.13.4 Load application equipment*
9.13.5 Apply chemicals using application equipment*
9.13.6 Follow established procedures for cleaning and sterilizing application equipment*
9.13.7 Maintain application records*
9.13.8 Recognize chemical injuries to plants*.

Competency 9.14: Harvest greenhouse plants

Competency Builders:

9.14.1 Follow general safety precautions related to the harvesting of greenhouse plants
9.14.2 Identify harvest stages
9.14.3 Cut plants
9.14.4 Count/bunch plants
9.14.5 Regulate the cold-storage unit temperature*
9.14.6 Observe industry standards in the harvesting of greenhouse plants*
9.14.7 Ensure quality control using postharvest date coding*
9.14.8 Grade plants*
9.14.9 Facilitate the harvesting of greenhouse plants using automation*

Option 2: Turf and Landscape Worker

Unit 10: Turf and Landscape Operations

Competency 10.1: Demonstrate knowledge of the turf and landscape industry

Competency Builders:

10.1.1 Explain the economic importance of the industry
10.1.2 Explain the environmental importance of the industry
10.1.3 Identify the regulatory aspects of the industry
10.1.4 Identify specific careers in the turf and landscape industry
10.1.5 Explain the physical nature of the work
10.1.6 Identify state licensing requirements for the industry
10.1.7 Identify employment opportunities in the industry
10.1.8 Identify continuing education opportunities within the industry
10.1.9 Identify professional organizations and trade journals related to the industry
10.1.10 Obtain pesticide license*

Competency 10.2: Demonstrate knowledge of plant physiology and growth

Competency Builders:

10.2.1 Differentiate between woody and herbaceous plants
10.2.2 Differentiate between evergreen and deciduous plants
10.2.3 Identify basic plant parts and their functions
10.2.4 Explain the photosynthesis process and its function
10.2.5 Identify the functions of roots, stems, and leaves
10.2.6 Identify the requirements for healthy plant growth
10.2.7 Compare taproot and fibrous root systems
10.2.8 Identify techniques for conserving water

Competency 10.3: Select plants

Competency Builders:

10.3.1 Identify local plants
10.3.2 Obtain information on plant materials using standard references
10.3.3 Classify turf and landscape plants as monocots or dicots
10.3.4 Classify turf and landscape plants as annuals, biennials, or perennials
10.3.5 Classify turf and landscape plants according to scientific name
10.3.6 Classify turf and landscape plants according to growth habit
10.3.7 Classify flowering trees and shrubs according to the sequence in which they bloom*
10.3.8 Identify plants suitable for the environmental conditions
10.3.9 Identify improved varieties
10.3.10 Evaluate nursery plant materials
10.3.11 Select outdoor bulbs
10.3.12 Select annual flowers
10.3.13 Select perennial flowers

Continued

Competency 10.3: ***Select plants—Continued***

10.3.14 Select shade trees
10.3.15 Select ornamental trees
10.3.16 Select shrubs
10.3.17 Select ground covers and vines
10.3.18 Select conifers
10.3.19 Select turfgrasses
10.3.20 Select plants for wildlife food and nesting
10.3.21 Select grasses

Competency 10.4: Plan landscape designs

Competency Builders:

10.4.1 Explain the reasons for landscaping
10.4.2 Identify the general objectives for developing a landscape plan
10.4.3 Identify the characteristics of the three basic areas of a home landscape
10.4.4 Analyze site conditions
10.4.5 Interpret soil survey maps*
10.4.6 Consider environmental conditions in determining plant requirements
10.4.7 Select plant and seed varieties to be used
10.4.8 Determine correct slope for adequate drainage
10.4.9 Calculate square footage of lawn
10.4.10 Calculate cubic measurements of soil
10.4.11 Identify the hardscape elements of a landscape design
10.4.12 Identify standard drafting equipment and the functions of each type
10.4.13 Lay out landscape designs using drafting equipment
10.4.14 Lay out landscape designs using AutoCAD*
10.4.15 Create spatial concepts
10.4.16 Depict existing plant material and objects on a landscape design
10.4.17 Draw landscape symbols
10.4.18 Locate focal point
10.4.19 Use textural triangle*
10.4.20 Draw plan to scale
10.4.21 Design residential plantings
10.4.22 Design vegetable gardens
10.4.23 Design outdoor privacy areas
10.4.24 Design commercial plantings
10.4.25 Design public area plantings
10.4.26 Design theme gardens
10.4.27 Design service areas
10.4.28 Design golf courses*
10.4.29 Design athletic fields*
10.4.30 Design xeroscaping*
10.4.31 Enhance finished plans using color*
10.4.32 Evaluate landscape plans
10.4.33 Construct landscape models*

Competency 10.5: Test soil and plant tissues

Competency Builders:

10.5.1 Take soil and plant tissue samples
10.5.2 Prepare soil and plant tissues to be tested
10.5.3 Perform basic soil test
10.5.4 Record test results
10.5.5 Interpret the results of soil and plant tissue tests*

Competency 10.6: Prepare for landscape and turf installation

Competency Builders:

10.6.1 Interpret landscape plans
10.6.2 Determine quantities of materials needed
10.6.3 Interpret seed and bulb tag information
10.6.4 Determine seeding rates
10.6.5 Determine planting depths
10.6.6 Determine planting times
10.6.7 Determine correct slope for adequate drainage
10.6.8 Identify underground utilities in the area
10.6.9 Plan planting schedules
10.6.10 Plan soil erosion controls
10.6.11 Select mulch variety

Competency 10.7: Prepare landscape and turfgrass area

Competency Builders:

10.7.1 Follow general safety precautions related to equipment operation
10.7.2 Define area
10.7.3 Establish rough grade
10.7.4 Create contour
10.7.5 Incorporate soil amendments
10.7.6 Establish finish grade

Competency 10.8: Process shipped landscape and turfgrass products

Competency Builders:

10.8.1 Follow general safety precautions related to shipping operations
10.8.2 Unload products
10.8.3 Unpack products
10.8.4 Load products
10.8.5 Secure load
10.8.6 Monitor quality control
10.8.7 Maintain shipping and receiving records

Competency 10.9: Establish turf and landscape

Competency Builders:

10.9.1 Follow general safety precautions related to turf and landscape operations
10.9.2 Follow landscape plan
10.9.3 Plant seeds
10.9.4 Plant bulbs
10.9.5 Plant annual and perennial plants
10.9.6 Plant shrubs
10.9.7 Plant ground covers
10.9.8 Plant drought-resistant and disease-resistant cultivars
10.9.9 Plant endophyte-enhanced turfgrass
10.9.10 Plant trees
10.9.11 Lower/raise grade around trees
10.9.12 Wrap trees
10.9.13 Stake and/or guy trees
10.9.14 Water-in plant material
10.9.15 Lay sod
10.9.16 Install landscape fabric
10.9.17 Apply mulch
10.9.18 Install edging
10.9.19 Perform final cleanup
10.9.20 Develop turf management schedule

Competency 10.10: Fertilize plants

Competency Builders:

10.10.1 Follow general safety precautions related to the use of fertilizers
10.10.2 Identify symptoms of nutrient deficiency
10.10.3 Determine nutrient requirements
10.10.4 Differentiate between organic and inorganic (chemical) fertilizers
10.10.5 Determine kind of fertilizer and soil amendments to apply
10.10.6 Interpret fertilizer labels
10.10.7 Interpret manufacturer's fertilization-rate charts
10.10.8 Calculate square footage of area to be treated
10.10.9 Determine amount of fertilizer and soil amendments to apply
10.10.10 Determine application pattern
10.10.11 Mix fertilizer solutions
10.10.12 Identify application methods
10.10.13 Select application method
10.10.14 Apply liquid fertilizers manually
10.10.15 Apply dry fertilizers manually
10.10.16 Calibrate fertilizer application equipment
10.10.17 Apply fertilizers using a fertilizer injector
10.10.18 Apply organic fertilizers
10.10.19 Apply polymers
10.10.20 Apply timed-release fertilizer
10.10.21 Comply with prescribed chemical re-entry times

Continued

Competency 10.10: Fertilize plants—Continued

10.10.22 Identify symptoms of fertilizer burn
10.10.23 Follow established safety procedures for storing and handling chemicals and fertilizer
10.10.24 Observe safety precautions when handling fertilizer spills
10.10.25 Follow procedures for personal cleanup after handling fertilizer

Competency 10.11: Maintain landscape plants

Competency Builders:

10.11.1 Follow general safety precautions related to plant maintenance
10.11.2 Cultivate plants
10.11.3 Water plants
10.11.4 Check for symptoms of over- and underwatering
10.11.5 Apply mulches
10.11.6 Apply growth-regulating compounds
10.11.7 Shear hedges
10.11.8 Prune shrubs (e.g., branches, roots, tops)
10.11.9 Prune trees (e.g., branches, roots, tops)
10.11.10 Remove fallen leaves
10.11.11 Remove old flowers
10.11.12 Compost plant debris
10.11.13 Transplant bulbs, corms, and tubers
10.11.14 Maintain plants on arbors and trellises
10.11.15 Stake trees
10.11.16 Provide plants with protection against adverse weather
10.11.17 Perform overwintering tasks for container-grown plants

Competency 10.12: Maintain turfgrasses

Competency Builders:

10.12.1 Follow general safety precautions related to turfgrass maintenance
10.12.2 Water turf
10.12.3 Aerate turf
10.12.4 Maintain nutrient levels
10.12.5 Apply topdressing to turfgrass areas
10.12.6 Apply growth-regulating compounds
10.12.7 Overseed turf
10.12.8 Determine desired grass height
10.12.9 Slice seed turf
10.12.10 Mow turf
10.12.11 Verticut turf
10.12.12 String-trim turf
10.12.13 Edge turf
10.12.14 Dethatch turf
10.12.15 Renovate turf
10.12.16 Fill in holes and depressions in turf
10.12.17 Relocate cups and tee markers
10.12.18 Compost clippings

Competency 10.13: Plan integrated pest management (IPM) control program

Competency Builders:

10.13.1 Follow general safety precautions related to the use of pest controls
10.13.2 Identify insects, diseases, and weeds
10.13.3 Classify insects according to feeding habits
10.13.4 Identify various types of insect and disease damage
10.13.5 Report insect and disease damage
10.13.6 Estimate pest population numbers
10.13.7 Assess degree of damage
10.13.8 Determine when controls are needed
10.13.9 Evaluate chemical/cultural/biological control options
10.13.10 Select appropriate control methods
10.13.11 Select biological controls whenever possible
10.13.12 Apply cultural controls
10.13.13 Identify disease-resistant and insect-resistant species
10.13.14 Select pesticides according to controlling action (e.g., stomach, contact, systemic)*
10.13.15 Interpret chemical labels and compatibility charts
10.13.16 Calculate area to be covered
10.13.17 Map chemical applications
10.13.18 Complete certification requirements for prescribed chemical applications*

Competency 10.14: Apply chemical pest-control treatments

Competency Builders:

10.14.1 Follow general safety precautions related to the use of chemical pest controls
10.14.2 Comply with local, state, federal, and EPA regulations regarding pesticide use
10.14.3 Identify pest baits
10.14.4 Calibrate application equipment
10.14.5 Mix chemicals
10.14.6 Load application equipment
10.14.7 Apply chemicals using application equipment
10.14.8 Follow planned application pattern
10.14.9 Follow established procedures for cleaning application equipment
10.14.10 Maintain application records
10.14.11 Comply with prescribed chemical re-entry times
10.14.12 Recognize chemical injuries to plants
10.14.13 Identify the symptoms of pesticide poisoning
10.14.14 Dispose of pesticide containers

Competency 10.15: Propagate plants

Competency Builders:

10.15.1 Differentiate between sexual and asexual plant propagation methods
10.15.2 Identify the steps in the asexual reproduction of plants
10.15.3 Prepare propagation media
10.15.4 Identify propagating and growing facilities and structures
10.15.5 Apply environmental controls (e.g., moisture, temperature, light)
10.15.6 Propagate plants (e.g., seed, graft, bud, layer, separate, divide, cut)
10.15.7 Describe the use of growth hormones

Competency 10.16: Transplant trees and shrubs

Competency Builders:

10.16.1 Dig out shrubs and trees
10.16.2 Reduce shoot-to-root ratio
10.16.3 Ball and burlap trees and shrubs
10.16.4 Determine planting depth
10.16.5 Transplant trees and shrubs into containers
10.16.6 Determine appropriate time of year to transplant plant materials
10.16.7 Transplant trees and shrubs from containers to outside locations

Competency 10.17: Plan interiorscapes

Competency Builders:

10.17.1 Select plants to fit space
10.17.2 Select plants that will do well indoors
10.17.3 Design interior layout for facility (e.g., shopping mall, hospital, nursing home, art museum)
10.17.4 Identify climatic conditions unique to interiorscaping
10.17.5 Provide for indoor plant needs
10.17.6 Maintain interiorscape

Competency 10.18: Survey for landscaping

Competency Builders:

10.18.1 Identify materials/equipment used in surveying
10.18.2 Interpret terms used in surveying
10.18.3 Apply surveying skills for landscaping purposes
10.18.4 Calculate areas in landscape
10.18.5 Locate house and boundaries
10.18.6 Mark off location of beds

Competency 10.19: Operate turf and landscape equipment

Competency Builders:

10.19.1 Follow general safety rules for equipment operation and maintenance
10.19.2 Perform predeparture functions
10.19.3 Mix gas and oil for two-cycle engine
10.19.4 Connect front-end-operated equipment
10.19.5 Connect 3-point-hitch equipment
10.19.6 Attach/detach power take-off equipment
10.19.7 Hitch towed equipment
10.19.8 Connect hydraulic lines
10.19.9 Connect electrical hookups
10.19.10 Connect safety chains

Competency 10.20 Install irrigation and drainage systems

Competency Builders:

10.20.1 Follow general safety precautions related to the installation of irrigation and drainage systems
10.20.2 Troubleshoot problems
10.20.3 Design a simple irrigation system
10.20.4 Locate existing underground waterlines
10.20.5 Tap into existing waterlines
10.20.6 Open trench lines
10.20.7 Backfill trenches
10.20.8 Identify types of pipe, pipe fittings, insulation, and plumbing fixtures
10.20.9 Cut pipe or tubing (e.g., polyvinyl-chloride [PVC], aluminum)
10.20.10 Thread metal pipe
10.20.11 Bore and sleeve pipe
10.20.12 Install flow-control devices
10.20.13 Install pipe and pipe fittings
10.20.14 Install valves and faucets
10.20.15 Repair valves and faucets
10.20.16 Winterize water delivery systems
10.20.17 Maintain filter systems
10.20.18 Replace gaskets
10.20.19 Unclog pipes
10.20.20 Install insulation
10.20.21 Test sprinkler spray patterns
10.20.22 Adjust sprinkler spray patterns
10.20.23 Repair access walls
10.20.24 Maintain automatic waterers
10.20.25 Install sprinkler heads and mist heads
10.20.26 Repair lines and nozzles on spray equipment
10.20.27 Repair broken pipes, sprinkler heads, mist heads, and valves
10.20.28 Wire a controller and a valve
10.20.29 Use a flow gauge
10.20.30 Construct open drainage ditches
10.20.31 Install drainage tile
10.20.32 Identify types of drainage systems and their characteristics
10.20.33 Identify methods for controlling surface drainage
10.20.34 Identify the parts of a subsurface drain
10.20.35 Identify the factors affecting selection of subsurface drainage systems
10.20.36 Construct culverts

Competency 10.21: Construct hardscapes

Competency Builders:

10.21.1 Follow general safety precautions related to hardscape construction
10.21.2 Select types of wall building materials
10.21.3 Design hardscapes*
10.21.4 Calculate amount of materials needed
10.21.5 Select tools for installation
10.21.6 Identify grade
10.21.7 Assure structure stability
10.21.8 Identify drainage techniques
10.21.9 Identify brick and paver patterns
10.21.10 Install edging

Option 3: Nursery and Garden Worker

Unit 11: Nursery and Garden Operations

Competency 11.1: Test soil, water, and plant tissues

Competency Builders:

11.1.1 Follow general safety precautions related to the testing of soil, water, and plant tissues
11.1.2 Take soil samples for testing
11.1.3 Take water samples for testing
11.1.4 Collect plant tissues for testing
11.1.5 Interpret soil test results received
11.1.6 Interpret water test results received
11.1.7 Interpret plant tissue test results received*
11.1.8 Determine pH levels
11.1.9 Determine soluble salt levels

Competency 11.2: Prepare media mixes

Competency Builders:

11.2.1 Follow general safety precautions related to the use of media materials
11.2.2 Identify media functions
11.2.3 Shred/mix planting media materials
11.2.4 Identify types of media pasteurization
11.2.5 Pasteurize media
11.2.6 Prepare media components
11.2.7 Prepare a soilless growing medium

Competency 11.3: Prepare for propagation

Competency Builders:

11.3.1 Follow general safety precautions related to propagation
11.3.2 Identify plant parts, structures, and functions
11.3.3 Identify the plant processes involved with plant growth
11.3.4 Identify the functions of roots, stems, leaves, and flowers
11.3.5 Identify seed parts
11.3.6 Identify the factors involved in seed germination
11.3.7 Identify methods for breaking dormancy
11.3.8 Identify plants and cuttings to be propagated
11.3.9 Grade cuttings for size
11.3.10 Select seeds and bulbs
11.3.11 Interpret seed and bulb tag information
11.3.12 Determine the environmental factors affecting propagation
11.3.13 Select the containers to be used
11.3.14 Select the media to be used
11.3.15 Prepare propagation media
11.3.16 Sanitize propagation equipment, areas, and containers
11.3.17 Determine the number of plants, seeds, or cuttings per container
11.3.18 Determine planting depth
11.3.19 Determine plant scheduling
11.3.20 Prepare seedbed
11.3.21 Pre-cool flower bulbs
11.3.22 Prepare a rooting bed
11.3.23 Treat bulbs to control fungus
11.3.24 Scarify difficult seeds with hard seed coats
11.3.25 Soak difficult seeds
11.3.26 Facilitate propagation using increased automation*

Competency 11.4: Propagate plants

Competency Builders:

11.4.1 Follow general safety precautions related to propagation
11.4.2 Conduct sexual and asexual plant propagation
11.4.3 Sow seeds
11.4.4 Plant bulbs
11.4.5 Force bulbs
11.4.6 Take cuttings
11.4.7 Plant cuttings
11.4.8 Apply rooting hormones
11.4.9 Plant plugs
11.4.10 Label plants and cuttings
11.4.11 Identify propagation problems
11.4.12 Identify types of mechanical seeders and components and the functions of each
11.4.13 Apply tissue culture methods*
11.4.14 Transplant rooted propagation materials

Competency 11.5: Care for plants

Competency Builders:

11.5.1 Follow general safety precautions related to plant care
11.5.2 Identify requirements for healthy plant growth
11.5.3 Label plants or cuttings
11.5.4 Disbud plants
11.5.5 Transplant seedlings and plugs
11.5.6 Transplant cuttings
11.5.7 Transplant plants
11.5.8 Space plants
11.5.9 Pinch plants
11.5.10 Apply growth-regulating compounds
11.5.11 Monitor plant growth (i.e., graphical tracking)
11.5.12 Tie plants to supports
11.5.13 Thin out weak shoots

Competency 11.6: Fertilize plants

Competency Builders:

11.6.1 Follow general safety precautions related to the use of fertilizers
11.6.2 Identify fertilization practices and terminology
11.6.3 Identify types of fertilizers
11.6.4 Differentiate between organic and inorganic fertilizers
11.6.5 Key out mineral deficiencies using a simple key
11.6.6 Identify symptoms of nutrient deficiency
11.6.7 Describe the effects of nitrogen, phosphorus, and potassium on plant growth
11.6.8 Determine kind of fertilizer and soil amendments to apply
11.6.9 Interpret fertilizer labels
11.6.10 Interpret manufacturer's fertilization-rate charts
11.6.11 Mix fertilizer solutions
11.6.12 Apply liquid fertilizers manually
11.6.13 Apply dry fertilizers manually
11.6.14 Calibrate fertilizer application equipment
11.6.15 Apply fertilizers using a fertilizer injector
11.6.16 Identify symptoms of toxicities*
11.6.17 Identify the short- and long-term impact of fertilizer on people and the environment*

Competency 11.7: Identify plant diseases*

Competency Builders:

11.7.1 Identify disease organism structures*
11.7.2 Differentiate between fungal, viral, and bacterial disorders*
11.7.3 Diagram the fungal process of life*

Competency 11.8: Identify insect pests*

Competency Builders:

11.8.1 Identify major insect orders and examples of each*
11.8.2 Identify the characteristics of no metamorphosis, gradual metamorphosis, and complete metamorphosis*
11.8.3 Differentiate between no metamorphosis, gradual metamorphosis, and complete metamorphosis*
11.8.4 Provide examples of each type of metamorphosis*
11.8.5 Calculate the scope of insect damage in agricultural losses in dollars*

Competency 11.9: Identify weeds

Competency Builders:

11.9.1 Define *weed*
11.9.2 Differentiate between annual, perennial, and biennial weeds
11.9.3 Identify specific weeds
11.9.4 Identify types of chemical controls for treating weeds
11.9.5 Describe the purposes and types of mulch

Competency 11.10: Plan pest-control programs

Competency Builders:

11.10.1 Follow general safety precautions related to the use of pest controls
11.10.2 Identify various types of pest damage
11.10.3 Estimate pest population numbers
11.10.4 Assess degree of damage
11.10.5 Report degree of damage
11.10.6 Identify treatments for plant diseases
11.10.7 Differentiate between preemergent and postemergent weed treatments
11.10.8 Identify chemical/cultural/biological control options
11.10.9 Select biological controls whenever possible*
11.10.10 Interpret chemical labels and compatibility charts
11.10.11 Categorize pesticides according to controlling action (e.g., stomach, contact, systemic)*
11.10.12 Calculate pesticide concentrations
11.10.13 Identify application times, frequency, method, and amounts
11.10.14 Prescribe program of treatment for a specific nursery crop
11.10.15 Prescribe program of treatment for noxious weeds
11.10.16 Complete certification requirements for prescribed chemical applications*

Competency 11.11: Apply chemical treatments

Competency Builders:

11.11.1 Follow general safety precautions related to the use of chemicals
11.11.2 Calibrate application equipment
11.11.3 Mix chemicals
11.11.4 Load application equipment
11.11.5 Apply chemicals using application equipment
11.11.6 Follow established procedures for cleaning and sterilizing application equipment
11.11.7 Maintain application records
11.11.8 Recognize chemical injuries to plants

Competency 11.12: Harvest nursery plants

Competency Builders:

11.12.1 Follow general safety precautions related to the harvesting of nursery plants
11.12.2 Identify harvest stages
11.12.3 Handle bare-root and containerized plants
11.12.4 Count/bunch plants
11.12.5 Regulate the cold-storage unit temperature
11.12.6 Observe industry standards in the harvesting of nursery plants
11.12.7 Grade plants
11.12.8 Ball and burlap plants
11.12.9 Label harvested plants by common name
11.12.10 Label harvested plants by scientific name*
11.12.11 Facilitate the harvesting of nursery plants using automation*

Occupational Competency Analysis Profile:

Employability

Unit 1: Career Development

Competency 1.1: Investigate career options

Competency Builders:

1.1.1 Determine interests and aptitudes
1.1.2 Identify career options
1.1.3 Research interests, knowledge, abilities, and skills needed in an occupation
1.1.4 Select careers that best match interests and aptitudes
1.1.5 Identify advantages and disadvantages of career options, including self-employment and nontraditional careers

Competency 1.2: Utilize career information

Competency Builders:

1.2.1 Identify a range of career information resources
1.2.2 Use a range of resources to obtain career information (e.g., handbooks, career materials, labor market information, and computerized career-information delivery systems)
1.2.3 Demonstrate knowledge of various classification systems that categorize occupations and industries (e.g., *Dictionary of Occupational Titles*)
1.2.4 Describe the educational requirements of various occupations
1.2.5 Identify individuals in selected occupations as possible information resources, role models, or mentors
1.2.6 Describe the impact of factors such as population, climate, employment trends, and geographic location on occupational opportunities
1.2.7 Assess differences in the wages, benefits, annual incomes, cost of living, and job opportunties associated with selected career options
1.2.8 Determine labor market projections for selected career options

Competency 1.3: Participate in a career exploration activity

Competency Builders:

1.3.1 Identify career exploration activities (e.g., job shadowing, mentoring, volunteer experiences, part-time employment, and cooperative education)
1.3.2 Compare traits, skills, and characteristics required for specific career choices with individual's traits, skills, and characteristics
1.3.3 Recognize potential conflicts between personal characteristics and career choice areas
1.3.4 Describe the impact of exploration activities on current career choices

Competency 1.4: Assess the relationship between educational achievement and career planning

Competency Builders:

1.4.1 Describe how skills developed in academic and vocational programs relate to career goals
1.4.2 Describe how education relates to the selection of a college major, further training, and/or entry into the job market
1.4.3 Identify skills that can apply to a variety of occupational requirements
1.4.4 Explain the importance of possessing learning skills in the workplace

Competency 1.5: Develop an individual career plan

Competency Builders:

1.5.1 Identify career goal(s)
1.5.2 Identify worker conditions, education, training, and employment opportunities related to selected career goal(s)
1.5.3 Describe school and community resources available to help achieve career goal(s)
1.5.4 Identify career ladders possible within selected career goal(s)*
1.5.5 Identify additional experiences needed to move up identified career ladders*
1.5.6 Recognize that changes may require retraining and upgrading of employees' skills

Competency 1.6: Annually review/revise the individual career plan

Competency Builders:

1.6.1 Identify experiences that have reinforced selection of the specific career goal(s) listed on the individual career plan
1.6.2 Identify experiences that have changed the specific career goal(s) listed on the individual career plan
1.6.3 Modify the career goals(s) and educational plans on the individual career plan
1.6.4 Ensure that parents or guardians provide input into the individual career plan process
1.6.5 Identify the correlation between the individual career plan and the actual courses to be taken in high school
1.6.6 Identify the correlation between the individual career plan and postsecondary training, adult education, or employment

Unit 2: Decision Making and Problem Solving

Competency 2.1: Apply decision-making techniques in the workplace

Competency Builders:

2.1.1 Identify the decision to be made
2.1.2 Compare alternatives
2.1.3 Determine the consequences of each alternative
2.1.4 Make decisions based on values and goals
2.1.5 Evaluate the decision made

Competency 2.2: Apply problem-solving techniques in the workplace

Competency Builders:

2.2.1 Diagnose the problem, its urgency, and its causes
2.2.2 Identify alternatives and their consequences in relation to the problem
2.2.3 Recognize multicultural and nonsexist dimensions of problem solving
2.2.4 Explore possible solutions to the problem using a variety of resources
2.2.5 Compare/contrast the advantages and disadvantages of each solution
2.2.6 Determine appropriate action
2.2.7 Implement action
2.2.8 Evaluate results of action implemented

Unit 3: Work Ethic

Competency 3.1: Evaluate the relationship of self-esteem to work ethic

Competency Builders:

3.1.1 Identify special characteristics and abilities in self and others
3.1.2 Identify internal and external factors that affect self-esteem
3.1.3 Identify how individual characteristics relate to achieving personal, social, educational, and career goals
3.1.4 Identify the relationship between personal behavior and self-concept

Competency 3.2: Analyze the relationship of personal values and goals to work ethic both in and out of the workplace

Competency Builders:

3.2.1 Distinguish between values and goals
3.2.2 Determine the importance of values and goals
3.2.3 Evaluate how one's values affect one's goals
3.2.4 Identify own short- and long-term goals
3.2.5 Prioritize own short- and long-term goals
3.2.6 Identify how one's values are reflected in one's work ethic
3.2.7 Identify how interactions in the workplace affect one's work ethic
3.2.8 Identify how life changes affect one's work ethic

Competency 3.3: Demonstrate work ethic

Competency Builders:

3.3.1 Examine factors that influence work ethic
3.3.2 Display initiative
3.3.3 Demonstrate dependable attendance and punctuality
3.3.4 Demonstrate organizational skills
3.3.5 Adhere to schedules and deadlines
3.3.6 Demonstrate a willingness to learn
3.3.7 Demonstrate a willingness to accept feedback and evaluation
3.3.8 Demonstrate interpersonal skills required for working with and for others
3.3.9 Describe appropriate employer-employee interactions for various situations
3.3.10 Express feelings and ideas in an appropriate manner for the workplace

Competency 3.4: Demonstrate safety skills

Competency Builders:

3.4.1 Practice safe work habits
3.4.2 Identify safety hazards
3.4.3 Employ preventative safety measures
3.4.4 Demonstrate appropriate care and use of equipment and facilities to ensure safety
3.4.5 Comply with safety and emergency procedures

Unit 4: Job-Seeking Skills

Competency 4.1: Prepare for employment

Competency Builders:

4.1.1 Identify traditional and nontraditional employment sources
4.1.2 Utilize employment sources
4.1.3 Research job opportunities, including nontraditional careers
4.1.4 Interpret equal employment opportunity laws
4.1.5 Explain the critical importance of personal appearance, hygiene, and demeanor throughout the employment process
4.1.6 Prepare for generic employment tests and those specific to an occupation/organization

Competency 4.2: Develop a résumé

Competency Builders:

4.2.1 Identify personal strengths and weaknesses
4.2.2 List skills and/or abilities, career objective(s), accomplishments/achievements, educational background, work experience, volunteer/community contributions, and organizational memberships
4.2.3 Select an acceptable résumé format
4.2.4 Use correct grammar and spelling and concise wording
4.2.5 Secure references
4.2.6 Complete the résumé

Competency 4.3: Complete the job application process

Competency Builders:

4.3.1 Explain the importance of an application form
4.3.2 Obtain job application forms
4.3.3 Demonstrate appropriate behaviors (e.g., personal appearance, hygiene, and demeanor) for obtaining job application forms in person
4.3.4 Describe methods for handling illegal questions on job application forms
4.3.5 Demonstrate legible written communication skills using correct grammar and spelling and concise wording
4.3.6 Return application to appropriate person
4.3.7 Request interview
4.3.8 Follow up on application status

Competency 4.4: Demonstrate interviewing skills

Competency Builders:

4.4.1 Investigate interview procedures
4.4.2 Demonstrate appropriate behaviors (e.g. appearance, hygiene, and demeanor) for the interview
4.4.3 Demonstrate question-and-answer techniques
4.4.4 Demonstrate methods for handling difficult and/or illegal interview questions
4.4.5 Use correct grammar and concise wording

Competency 4.5: Secure employment

Competency Builders:

4.5.1 Identify present and future employment opportunities within an occupation/organization
4.5.2 Research the organization/company
4.5.3 Use follow-up techniques to enhance employment potential
4.5.4 Evaluate job offer(s)
4.5.5 Respond to job offer(s)

Unit 5: Job Retention and Career Advancement Skills

Competency 5.1: Analyze the organizational structure of the workplace

Competency Builders:

5.1.1 Identify employer expectations regarding job performance, work habits, attitudes, personal appearance, and hygiene
5.1.2 Comply with company policies and procedures
5.1.3 Examine the role/relationship between employee and employer
5.1.4 Recognize opportunities for advancement and reasons for termination
5.1.5 Recognize the organization's ethics.

Competency 5.2: Maintain positive relations with others

Competency Builders:

5.2.1 Exhibit appropriate work habits and attitudes
5.2.2 Identify behaviors for establishing successful working relationships
5.2.3 Cooperate through teamwork and group participation
5.2.4 Demonstrate a willingness to compromise
5.2.5 Identify methods for dealing with harassment, bias, and discrimination based on race, color, national origin, gender, religion, disability, or age
5.2.6 Cooperate with authority
5.2.7 Accept supervision

Competency 5.3: Demonstrate accepted social and work behaviors

Competency Builders

5.3.1 Demonstrate a positive attitude
5.3.2 Demonstrate accepted conversation skills
5.3.3 Use good manners
5.3.4 Accept responsibility for assigned tasks
5.3.5 Demonstrate personal hygiene
5.3.6 Demonstrate knowledge of a position
5.3.7 Perform quality work

Competency 5.4: Analyze opportunities for personal and career growth*

Competency Builders:

5.4.1 Determine opportunities within chosen occupation/organization*
5.4.2 Determine other career opportunities outside chosen occupation/ organization*
5.4.3 Evaluate the factors involved in considering a new position within or outside an occupation/ organization*
5.4.4 Exhibit characteristics needed for advancement*

Unit 6: Technology in the Workplace

Competency 6.1: Demonstrate knowledge of technology issues

Competency Builders:

6.1.1 Demonstrate knowledge of the characteristics of technology
6.1.2 Demonstrate knowledge of how technology systems are applied
6.1.3 Assess the impact of technology on the individual, society, and environment
6.1.4 Demonstrate knowledge of the evolution of technology
6.1.5 Identify how people, information, tools and machines, energy, capital, physical space, and time influence the selection and use of technology
6.1.6 Identify legal and ethical issues related to technology (e.g., confidentiality, information sharing, copyright protection)

Competency 6.2: Demonstrate skills related to technology issues

Competency Builders:

6.2.1 Exhibit willingness to adapt to technological change
6.2.2 Utilize technological systems
6.2.3 Utilize a variety of resources and processes to solve technological problems
6.2.4 Employ higher-order thinking skills for solving technological problems
6.2.5 Work as a team member in solving technological problems
6.2.6 Use technology in a safe and responsible manner
6.2.7 Apply science, mathematics, communication, and social studies concepts to solve technological problems
6.2.8 Demonstrate ingenuity and creativity in the use of technology*
6.2.9 Utilize a formal method (systems approach) in solving technological problems*

Unit 7: Lifelong Learning

Competency 7.1: Apply lifelong learning practices to individual situations

Competency Builders:

7.1.1 Define lifelong learning
7.1.2 Identify factors that cause the need for lifelong learning
7.1.3 Identify changes that may require the retraining and upgrading of employee's skills
7.1.4 Identify avenues for lifelong learning
7.1.5 Participate in lifelong learning activities

Competency 7.2: Adapt to change

Competency Builders:

7.2.1 Analyze the causes and effects of change
7.2.2 Identify the effect of change on goals
7.2.3 Identify the importance of flexibility when reevaluating goals
7.2.4 Evaluate the need for lifelong learning experiences in adapting to change

Unit 8: Economic Education

Competency 8.1: Analyze how an economy functions as a whole

Competency Builders:

8.1.1 Describe how individuals and societies make choices to satisfy needs and wants with limited resources
8.1.2 Identify how production factors (land, labor, capital, and entrepreneurship) are used to produce goods and services
8.1.3 Illustrate how individuals and households exchange their resources for the income they use to buy goods and services
8.1.4 Explain how individuals and business firms use resources to produce goods and services to generate income
8.1.5 Identify characteristics of command, market, and traditional economies*
8.1.6 Describe how all levels of government assess taxes in order to provide services

Competency 8.2: Analyze how an economic system is a framework within which decisions are made by individuals and groups

Competency Builders:

8.2.1 List several individuals and groups that make economic decisions at the local, state, and national levels
8.2.2 Identify the important roles that local, state, and national governments play in a market economy

Continued

*Advancing

Competency 8.2: ***Analyze how an economic system is a framework within which decisions are made by individuals and groups****—Continued*

8.2.3 List examples of how government decisions affect individuals
8.2.4 Identify how geographic locations affect the political and economic systems of the world
8.2.5 Evaluate how markets allocate goods and services
8.2.6 Explain how resources, goods, and services are exchanged in markets
8.2.7 Explain competition and its effect on the market

Competency 8.3: Analyze the importance of making informed personal financial decisions

Competency Builders:

8.3.1 Describe the need for personal management records
8.3.2 Create a personal budget
8.3.3 Create a budget for a family of four for one month
8.3.4 Explain how credit affects personal/family finances
8.3.5 Identify steps to avoid credit problems
8.3.6 Make informed consumer choices in response to personal needs and wants
8.3.7 Identify factors that influence consumer decisions (e.g., advertisements, peer groups, price, and location)
8.3.8 Explain the costs and benefits for individuals of various types of taxation at the local, state, and federal levels

Unit 9: Balancing Work and Family

Competency 9.1: Analyze the effects of family on work

Competency Builders:

9.1.1 Recognize how family values, goals, and priorities are reflected in the workplace
9.1.2 Identify present and future family structures and responsibilities
9.1.3 Describe personal and family roles
9.1.4 Analyze concerns of working parent(s)
9.1.5 Examine how family responsibilities can conflict with work
9.1.6 Identify ways to resolve family-related conflicts
9.1.7 Explain how to use support systems/community resources to help resolve family-related conflicts

Competency 9.2: Analyze the effects of work on family

Competency Builders:

9.2.1 Identify responsibilities associated with paid and nonpaid work
9.2.2 Compare the advantages and disadvantages of multiple incomes
9.2.3 Explain how work can conflict with family responsibilities
9.2.4 Explain how work-related stress can affect families
9.2.5 Identify family support systems and resources

Unit 10: Citizenship in the Workplace

Competency 10.1: Exercise the rights and responsibilities of citizenship in the workplace

Competency Builders:

10.1.1 Identify the basic rights and responsibilities of citizenship in the workplace
10.1.2 Identify situations in which compromise is necessary
10.1.3 Examine how individuals from various backgrounds contribute to the workplace
10.1.4 Demonstrate initiative to facilitate cooperation
10.1.5 Give/receive constructive criticism to enhance cooperation

Competency 10.2: Prepare to work in a multicultural society

Competency Builders:

10.2.1 Identify ways to live in a multicultural society with mutual respect and appreciation for others
10.2.2 Examine how culture and experience create differences in people
10.2.3 Demonstrate respect for the contributions made by all people
10.2.4 Investigate personal cultural background as a means of developing self-respect
10.2.5 Make personal choices that reduce discrimination, isolation, and prejudice
10.2.6 Work effectively with people irrespective of their race, gender, religion, ethnicity, disability, age, or cultural background

Unit 11: Leadership

Competency 11.1: Evaluate leadership styles appropriate for the workplace

Competency Builders:

11.1.1 Identify characteristics of effective leaders
11.1.2 Compare leadership styles
11.1.3 Demonstrate effective delegation skills
11.1.4 Investigate empowerment concepts
11.1.5 Identify opportunities to lead in the workplace

Competency 11.2: Demonstrate effective teamwork skills

Competency Builders:

11.2.1 Identify the characteristics of a valuable team member
11.2.2 Identify methods of involving each team member
11.2.3 Contribute to team efficiency and success
11.2.4 Determine ways to motivate team members

Competency 11.3: Utilize effective communication skills

Competency Builders:

11.3.1 Identify the importance of listening
11.3.2 Demonstrate effective listening skills
11.3.3 Demonstrate assertive communication techniques
11.3.4 Recognize the importance of verbal and nonverbal cues and messages
11.3.5 Prepare written material
11.3.6 Analyze written material
11.3.7 Give/receive feedback
11.3.8 Communicate thoughts
11.3.9 Use appropriate language
11.3.10 Follow oral and written instructions
11.3.11 Demonstrate effective telephone techniques
11.3.12 Identify technology in communications

Unit 12: Entrepreneurship

Competency 12.1: Evaluate the role of small business

Competency Builders:

12.1.1 Identify the impact of small business on the local economy
12.1.2 Examine the relationship of small business to a national (USA) and global economy
12.1.3 Identify factors that contribute to the success of small business
12.1.4 Identify factors that contribute to the failure of small business
12.1.5 Identify the components of a business plan

Competency 12.2: Examine entrepreneurship as a personal career option

Competency Builders:

12.2.1 Evaluate personal interests and skills
12.2.2 Compare personal interests and skills with those necessary for entrepreneurship
12.2.3 Determine motives for becoming an entrepreneur
12.2.4 Identify the advantages and disadvantages of owning a small business
12.2.5 Compare business ownership to working for others

Notes

Academic Job Profile

The Purpose of Job Profiling

Developed by American College Testing (ACT), the purpose of the Job Profiling process is to identify the **level** of applied academic skills that, according to business and industry, students must master to qualify for and be successful in their occupation of choice. The results of Job Profile "leveling" can help teachers to better target instruction toward their students' needs.

As part of the Ohio Vocational Competency Assessment (OVCA) program, the Vocational Instructional Materials Laboratory (VIML) at The Ohio State University has conducted Job Profiling workshops in which representatives of business, industry, labor, and community organizations identified the academic skill levels needed by entry-level workers in the occupational areas covered by the OCAPs. The Job Profiling, which was carried out in spring 1994 and spring 1995, was sponsored by the Ohio Department of Education, Division of Vocational and Adult Education.

OVCA—What Is It?

The Ohio Vocational Competency Assessment (or OVCA) package consists of two assessment components: OCAP and Work Keys. Together they measure entry-level occupational, academic, and employability skills. All OVCA items are criterion-referenced, use a multiple-choice format, and are administered using a traditional paper-and-pencil method. The OVCA is designed to do the following:

- Provide one dimension of a multi-assessment strategy for career passport credentialing
- Evaluate learner readiness for jobs requiring specific occupational, academic, and employability skills
- Assist educators in curriculum development
- Provide state-aggregated learning gain scores to comply with the regulations in the Carl D. Perkins Vocational and Applied Technology Act of 1990

OCAP. The OCAP component of OVCA assesses students in occupational skills—employment requirements—in a particular occupational area. Assessment is based on the core competencies identified through the OCAP process, and each multiple-choice assessment item is correlated to those essential competencies.

Work Keys. The Work Keys component, developed by ACT, measures students' applied academic skills. All OVCA packages contain two Work Keys assessments:

- *Applied Mathematics* measures students' ability to analyze, set up, and solve math problems typically found in the workplace.
- *Locating Information* measures students' ability to use graphic documents to insert, extract, and apply information.

In addition, certain taxonomies will use the following Work Keys assessments:

- *Reading for Information* will be used by Business, Marketing, Home Economics, Health Education, and Cosmetology taxonomies.
- *Applied Technology* will be used by Trade and Industrial and Agricultural Education taxonomies.

Other optional Work Keys assessments, not included in the basic OVCA package, are *Teamwork*, *Listening*, and *Writing*.

Each Work Keys assessment is further broken down into four to five levels of achievement, with higher numbers indicating higher achievement in the assessed skill (descriptions of the levels for each Work Keys assessment are provided on pp. 49-55). For each academic skill, the Job Profiling process identifies the level required for successful entry into an occupational area.

Job Profiling—How It Works

VIML's Job Profiling process was initiated by mailing surveys to current workers in OCAP occupations all across Ohio. The survey's purpose: to have actual workers in specific occupations rate job tasks according to each task's frequency and criticality—that is, the amount of time spent performing each task relative to other tasks and the importance of each task to overall job performance.

To complete the survey, participants examined OCAP competencies for their occupation. Based on the survey's results, VIML staff produced a list of the most critical competencies in each occupation.

The next stage of Job Profiling was to convene committees of subject-matter experts to perform "leveling," which involved the following tasks:

- Examining the frequency and criticality competency lists for an occupation
- Reviewing the levels associated with each of the seven Work Keys academic skills: *Locating Information, Reading for Information, Applied Mathematics, Applied Technology, Listening, Writing,* and *Teamwork*
- Identifying the level of skill students must master relative to each Work Keys academic skill in order to successfully perform the occupational competencies

Finally, in 1995, the initial leveling of Work Keys academic skills for the occupational area covered by this OCAP was revalidated by the new panel of expert workers convened to update the OCAP (see inside back cover).

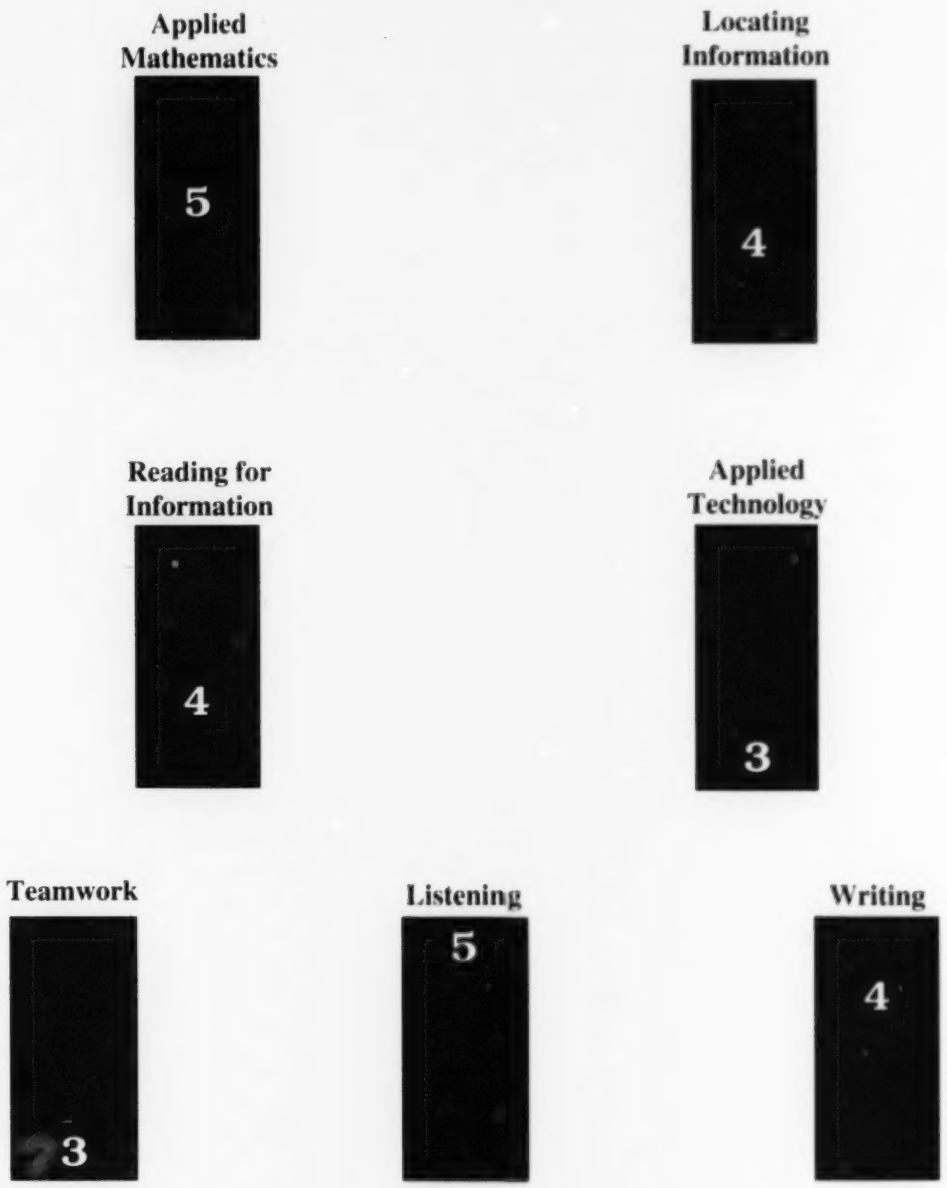
Example of Job Profiling

For every occupational area, there are shaded graphs to represent each of the seven Work Keys academic skills. Each graph shows the range of levels for that particular skill; the shading represents the academic skill level required by an entry-level worker in that occupation, as determined by the Job Profiling committee. For example:

Applied Mathematics

In the example shown, Applied Mathematics has a skill range of 3–7. The required skill level, determined by Job Profiling and shown by the highlighting, is 6.

Academic Job Profile: Horticulture



NOTE: Definitions of each level in each of the seven academic skill areas are provided on the pages that follow.

Levels of Work Keys Defined

The skills needed to achieve each level for each of the seven Work Keys* academic skills are as follows.

Applied Mathematics

Applied Mathematics measures skill in applying mathematical reasoning to work-related problems. There are five levels of complexity, 3 through 7, with Level 3 being the least complex and Level 7 the most complex. The levels build on each other, each incorporating the skills at the preceding levels.

Level 3

- Perform basic mathematical operations (addition, subtraction, multiplication, and division) and conversions from one form to another, using whole numbers, fractions, decimals, or percentages.
- Translate simple verbal problems into mathematical equations.
- Directly apply logical information provided to solve problems, including those with measurements and dollars and cents.

Level 4

- Perform one or two mathematical operations (such as addition, subtraction, or multiplication) on several positive or negative numbers. (Division of negative numbers is not covered until Level 5.)
- Add commonly known fractions, decimals, or percentages (e.g., ½, .75, 25%) or add three fractions that share a common denominator.
- Calculate averages, simple ratios, proportions, and rates, using whole numbers and decimals.
- Reorder verbal information before performing calculations.
- Read simple charts or graphs to obtain information needed to solve a problem.

Level 5

- Look up and calculate single-step conversions within English or non-English measurement systems (e.g., converting ounces to pounds or centimeters to meters) or between measurement systems (e.g., converting centimeters to inches).
- Make calculations using mixed units (e.g., hours and minutes).
- Determine what information, calculations, and unit conversions are needed to find a solution.

Level 6

- Calculate using negative numbers, fractions, ratios, percentages, mixed numbers, and formulas.
- Identify and correct errors in calculations.
- Translate complex verbal problems into mathematical expressions, using considerable setup and multiple-step calculations or conversions.

Level 7

- Solve problems requiring multiple steps of logic and calculation.
- Solve problems involving more than one unknown, nonlinear functions (e.g., rate of change), and applications of basic statistical concepts (e.g., error of measurement).
- Locate errors in multiple-step calculations.
- Solve problems with unusual content or format, or with incomplete or implicit information.

**Work Keys Score Interpretation Guide*, © 1994 by American College Testing (ACT). Used with permission.

Locating Information

Locating Information measures skill in using information taken from workplace graphics such as diagrams, blueprints, floor plans, tables, forms, graphs, charts, and instrument gauges. There are four levels of complexity, 3 through 6, with Level 3 being the least complex and Level 6 the most complex. The levels build on each other, each incorporating the skills at the preceding levels.

Level 3

- Find one or two pieces of information in elementary workplace graphics, such as simple order forms, bar graphs, tables, flowcharts, and floor plans.
- Fill in one or two pieces of information that are missing from elementary workplace graphics.

Level 4

- Find several pieces of information in straightforward workplace graphics, such as basic order forms, line graphs, tables, instrument gauges, maps, flowcharts, and diagrams.
- Summarize and/or compare information and trends in a single straightforward graphic.
- Summarize and/or compare information and trends among more than one straightforward workplace graphic, such as a bar chart and a data table showing related information.

Level 5

- Summarize and/or compare information and trends in single complicated workplace graphics, such as detailed forms, tables, graphs, maps, instrument gauges, and diagrams.
- Summarize and/or compare information and trends among more than one complicated workplace graphic, such as a bar chart and a data table showing related information.

Level 6

- Make decisions, draw conclusions, and/or apply information to new situations using several related and complex workplace graphics that contain a great amount of information or have challenging presentations (e.g., very detailed graphs, charts, tables, forms, maps, blueprints, diagrams).

Reading for Information

Reading for Information measures skill in reading and understanding work-related reading materials. There are five levels of complexity, 3 through 7, with Level 3 being the least complex and Level 7 the most complex. Although Level 3 is the least complex, it still represents a level of reading skill well above "no skill at all." The levels build on each other, each incorporating the skills at the preceding levels.

Level 3

- Identify uncomplicated key concepts and simple details.
- Recognize the proper placement of a step in a sequence of events, or the proper time to perform a task.
- Identify the meaning of words that are defined within a passage.
- Identify the meaning of simple words that are not defined within a passage.
- Recognize the application of instructions from a passage to situations that are described in the passage.

Level 4

- Identify details that are more subtle than those in Level 3.
- Recognize the application of more complex instructions, some of which involve several steps, to described situations.
- Recognize cause-effect relationships.

Level 5

- Identify the paraphrased definition of jargon or technical terms that are defined in a passage and recognize the application of jargon or technical terms to stated situations.
- Recognize the definition of acronyms that are defined in a passage.
- Identify the appropriate definition of words with multiple meanings.
- Recognize the application of instructions from a passage to new situations that are similar to the situations described in the reading materials.
- Recognize the applications of more complex instructions to described situations, including conditionals and procedures with multiple steps.

Level 6

- Recognize the application of jargon or technical terms to new situations.
- Recognize the application of complex instructions to new situations.
- Recognize the less-common meaning of a word with multiple meanings from context.
- Generalize from a passage to situations not described in the passage.
- Identify implied details.
- Explain the rationale behind a procedure, policy, or communication.
- Generalize from a passage to a somewhat similar situation.

Level 7

- Recognize the definitions of difficult, uncommon jargon or technical terms from context.
- Generalize from a passage to situations neither described in nor completely similar to those in a passage.

Applied Technology

Applied Technology measures skill in solving problems of a technological nature, involving the basic principles of mechanics, electricity, fluid dynamics, and thermodynamics as they apply to machines and equipment found in the workplace. There are four levels of complexity, 3 through 6, with Level 3 being the least complex and Level 6 the most complex. Although Level 3 is the least complex, it still represents a level of applied technology skill well above "no skill at all." The levels build on each other, each incorporating the skills at the preceding levels.

Level 3

- Apply the elementary physical principles underlying the operation of uncomplicated systems or tools.
- Recognize and identify relevant aspects of simple problems that involve one uncomplicated system or tool.
- Select appropriate methods or materials needed to solve problems.

Level 4

- Recognize, identify, and order relevant aspects of one moderately complex system or more than one uncomplicated system.
- Evaluate alternative solutions to determine the most appropriate one for the situation presented.

Level 5

- Solve problems based on one complex system, or one or more uncomplicated tools or systems.
- Understand and apply moderately difficult principles of mechanics, electricity, thermodynamics, and fluid dynamics, in addition to understanding complex machines and systems.
- Recognize, identify, and order relevant aspects of a problem before reaching an appropriate solution.

Level 6

- Solve problems that do not contain all the information needed to solve them, and/or in which the information provided may be out of logical order.
- Solve problems that contain extraneous information.
- Solve problems involving one or more tools or systems having a wide range of complexity.
- Apply difficult physical principles.
- Understand and correctly interpret the interaction of several complex systems.

Listening

Listening measures skill in listening to and understanding work-related messages; receiving information from customers, coworkers, or suppliers; and then writing down the information to communicate it to someone else. Students demonstrate their ability to distinguish and communicate critical information and noncritical information. **Critical information** consists of those details that the recipient of the message must have in order to understand the message and act upon it (e.g., names, phone numbers, addresses, times). **Noncritical information** can improve a message by providing details that further explain the message or its tone, but the absence of this noncritical information does not interfere with the recipient's ability to understand and accurately act upon the message. Each *Listening* level describes the **content and quality** of messages students write to describe an audio message.

Level 0

- No meaningful information, or totally inaccurate information.

Level 1

- Minimal pertinent information; enough context to provide clues as to gist of situation or source of further information.

Level 2

- Some pertinent information; may have incorrect critical information, but sketch of the situation is correct.

Level 3

- All the critical information that is present is correct; may be missing a few pieces of critical information.

Level 4

- All critical information is given and is correct; may be missing subtle details or tone; may have incorrect noncritical information that does not interfere with central meaning.

Level 5

- All critical information is present and correct; response conveys insight into situation through tone and/or subtle details.

Writing

Writing measures skill at writing work-related messages; receiving information from customers, co-workers, or suppliers; and then writing down the information to communicate it to someone else. Each *Writing* level rates the **writing mechanics** (such as sentence structure and grammar) **and writing style** of messages students write to describe an audio message.

Level 0

- An attempt is made at the message, but the message is completely garbled with no recognizable sentence structure.

Level 1

- Message conveyed inadequately; overall lack of proper sentence structure.

Level 2

- Message conveyed inadequately; weak sentence structure; large number of mechanical errors.

Level 3

- Message conveyed clearly; most sentences complete; some mechanical errors.

Level 4

- Message conveyed clearly; all sentences are complete; may have a few minor mechanical errors; may have a choppy style.

Level 5

- Message conveyed clearly; good sentence structure; no mechanical errors; highly appropriate for business setting and situation; smooth, logical style.

Teamwork

Teamwork measures skill in choosing behaviors and/or actions that simultaneously support team interrelationships and lead toward the accomplishment of work tasks. There are four levels of complexity, 3 through 6, with Level 3 being the least complex and Level 6 the most complex. Although Level 3 is the least complex, it still represents a level of teamwork skill well above "no skill at all." The levels build on each other, each incorporating the skills at the preceding levels.

Level 3

- Identify team goals and ways to work with other team members to accomplish those goals.
- Choose actions that support the ideas of other team members to accomplish team goals.
- Recognize that a team is having problems finishing a task and identify the cause of those problems.

Level 4

- Identify the organization of tasks and the time schedule that would help accomplish team goals efficiently and effectively.
- Select approaches that accept direction from other team members in order to accomplish tasks and to build and keep up good team relations.
- Identify behaviors that show appreciation for the personal and professional qualities of other team members and respect for their diversity.

Level 5

- Identify courses of action that give direction to other team members effectively.
- Choose approaches that encourage and support the efforts of other team members to further team relationships and/or task accomplishment.
- Consider the possible effects of alternative behaviors on both team relationships and team accomplishments and select the one that would best help the team meet its goals.

Level 6

- Identify the focus of team activity and select a new focus if that would help the team meet its goals more effectively.
- Select approaches that show the willingness to give and take direction as needed to further team goals (e.g., recognize the organization of team members' tasks that would best serve the larger goals of the team).
- Choose approaches that encourage a team to act as a unit and reach agreement when discussing specific issues.
- Identify actions that would help manage differences of opinion among team members, moving the team toward its goals while valuing and supporting individual diversity.

Notes

Academic Competencies

Total List of Academic Competencies

Three products of the Ohio Department of Education, Division of Curriculum, Instruction, and Professional Development, describe the academic skills that should be possessed by each student at the end of each grade level:

- *Model Competency-Based Language Arts Program*
- *Model Competency-Based Mathematics Program*
- *Model Competency-Based Science Program*

The following lists were derived from the academic competencies delineated for Grades 9-12 in these documents. Although the competencies are listed separately by grade level in the original documents, the levels were combined—and in some cases refined—for OCAP purposes, any overlap was eliminated, and a numbering system was imposed for ease of reference.

During the course of the OCAP workshops, each of the representatives from business, industry, labor, and community-based organizations was given a copy of these lists of academic competencies and instructed to circle the competencies that an entry-level employee should possess. The results from each panel were tallied to identify those required academic competencies most crucial to entry level in each specific occupational area. The results for this OCAP are presented on pp. 73-83.

Unit: Communications Skills

Subunit: Reading—Structure

Competencies:

RS1 Exhibit knowledge of language structure
RS2 Recognize that there may be more than one interpretation of reading selections
RS3 Recognize various literary devices (e.g., metaphor, simile, personification, hyperbole, pun, alliteration)
RS4 Recognize and discuss literary elements (e.g., plot, dialogue, theme, setting, characterization)
RS5 Develop and use an increasingly sophisticated vocabulary gained through context
RS6 Apply knowledge of language structure to reading
RS7 Explain why there may be more than one interpretation of reading selections
RS8 Recognize effect of literary devices on meaning
RS9 Analyze author's use of literary elements
RS10 Recognize relationship of structure to meaning
RS11 Describe various interpretations and levels of meaning in reading selections (e.g., symbolism, nuance)
RS12 Characterize author's use of literary devices
RS13 Characterize use of literary techniques (e.g., irony, satire, allegory, onomatopoeia)
RS14 Critique a variety of literature with regard to plot, dialogue, theme, setting, and characterization
RS15 Apply an expanding vocabulary gained through reading
RS16 Explain various interpretations and levels of meaning in reading selections (e.g., symbolism, nuance)
RS17 Analyze use of literary devices (e.g., extended metaphor, simile, personification, hyperbole, pun, alliteration)
RS18 Understand use of literary techniques (e.g., irony, satire, allegory, onomatopoeia)
RS19 Analyze and synthesize pieces of literature with regard to plot, dialogue, theme, setting, and characterization

Subunit: Reading—Meaning Construction

Competencies:

- RM1 Demonstrate ability to recognize appropriate pre-reading strategies
- RM2 Describe effectiveness of a reading selection
- RM3 Read to clarify personal thinking and knowledge
- RM4 Support interpretation of text by locating and citing specific information
- RM5 Develop personal response to a variety of literary works
- RM6 Recognize diverse literary interpretations
- RM7 Engage in self-selected reading activities
- RM8 Confirm and extend meaning in reading by researching new concepts and facts
- RM9 Self-monitor and apply corrective strategies when communication has been interrupted or lost
- RM10 Use features of literary genres to extend meaning
- RM11 Assess effectiveness of a selection read
- RM12 Use reading as a possible problem-solving strategy to clarify personal thinking and knowledge
- RM13 Use knowledge of semantic elements (e.g., figurative language, denotation, connotation, dialect) to clarify meaning when reading
- RM14 Predict, recognize, interpret, and analyze themes based on familiarity with author's work
- RM15 Compare and contrast literary genres
- RM16 Assess validity and quality of selection read (e.g., predict, summarize, analyze, infer)
- RM17 Clarify meaning when reading, using knowledge of literary devices, stylistic diction, and other semantic elements
- RM18 Compare personal reaction to critical assessment of a literary selection
- RM19 Assess validity of diverse literary interpretations
- RM20 Use reference books to find, evaluate, and synthesize information
- RM21 Identify tone of a literary work (e.g., ironic, serious, conversational, humorous)
- RM22 Critique validity of diverse literary interpretations
- RM23 Integrate personal reaction to and critical assessment of a literary selection

Subunit: Reading—Application

Competencies:

- RA1 Select and read material for personal enjoyment and information
- RA2 Read a variety of complete, unabridged works (e.g., self-selected or assigned stories, essays, nonfiction, plays, novels, poetry)
- RA3 Employ various reading strategies (e.g., scanning, skimming, reviewing, questioning, testing, retaining) according to purpose
- RA4 Participate in selection of books, materials, and topics for literature study groups
- RA5 Develop and apply knowledge of the interrelationship of concepts (e.g., construction of webs, graphs, timelines)
- RA6 Read selections from a variety of styles and formats, recognizing that style and format influence meaning
- RA7 Extend value of reading, writing, speaking, viewing, and listening by pursuing, through reading, new concepts and interests developed as a result of these activities
- RA8 Read extensively from the works of a particular author, and explain elements of author's style

Subunit: Reading—Multidisciplinary

Competencies:

- RM1 Connect themes and ideas across disciplines through literature
- RM2 Read to facilitate learning across curriculum
- RM3 Read to develop awareness of human rights and freedom
- RM4 Participate actively in a community of learners

RM5 Recognize and explain interaction between literature and various cultural domains (e.g., social, technological, political, economic)
RM6 Explore and analyze a variety of cultural elements, attitudes, beliefs, and value structures by reading and experiencing our diverse literary tradition, including works by men and women of many racial, ethnic, and cultural groups
RM7 Value thinking and language of others
RM8 Relate literature to historical period about which or in which it was written
RM9 Read to facilitate content learning

Subunit: Writing—Structure

Competencies:

WS1 Develop and expand a repertoire of organizational strategies (e.g., narration, comparison/contrast, and description) through practice and discussion
WS2 Clarify word choice according to audience, topic, and purpose
WS3 Locate and correct errors in usage, spelling, and mechanics (e.g., subject-verb agreement, parallel construction, pronoun reference, punctuation, capitalization, sentence structure) using a variety of resources
WS4 Recognize information gained from primary and secondary sources
WS5 Develop writing that contains ordered, related, well-developed paragraphs with sentences of varied lengths and patterns
WS6 Use information from a variety of sources to develop an integrated piece of writing
WS7 Evaluate and revise writing to focus on such things as audience, tone, and purpose
WS8 Recognize differences between documentation and reference list styles
WS9 Develop extended pieces of writing that contain ordered, related, well-developed paragraphs with sentences of varied lengths and patterns
WS10 Select from a repertoire of organization strategies a pattern appropriate to a topic (e.g., narration, example, detail, comparison/contrast, classification)
WS11 Synthesize information from a variety of sources to construct meaning
WS12 Refine word choice and tone according to audience, situation, and purpose
WS13 Appropriately cite information gained from primary and secondary sources
WS14 Use style manuals or software to prepare documentation and reference lists
WS15 Develop effectively organized pieces of expository writing containing strong voice, clear thesis, and well-developed ideas
WS16 Identify organization patterns appropriate to writing topic
WS17 Respond to others' suggested revisions to a writing piece

Subunit: Writing—Meaning Construction

Competencies:

WM1 Demonstrate knowledge of the recursive nature of the writing process by applying it appropriately to various topics, situations, and audiences (e.g., making connections between prior knowledge and new information, consulting other sources)
WM2 Develop criteria for writing evaluation using scoring guides (e.g., rubric/holistic scale, primary trait scoring) and peer/teacher assistance to clarify meaning
WM3 Respond to others' suggested revisions to a piece of writing (e.g., self-question, re-read, revise)
WM4 Use word processing, graphics, and publishing as aids for constructing meaning in writing
WM5 Engage in self-initiated writing activities
WM6 Incorporate personal criteria with generally accepted standards for writing evaluation
WM7 Evaluate, analyze, and synthesize information for writing
WM8 Evaluate own writing using personal and established scoring criteria
WM9 Assess personal/peer revisions to a writing piece
WM10 Recognize and refine personal writing styles

Subunit: Writing—Application

Competencies:

- WA1 Apply appropriate writing techniques (e.g., prewriting, drafting, revising, editing, presenting) suitable for varied writing tasks
- WA2 Use sentence-combining techniques to improve syntactic fluency and maturity
- WA3 Write in response to prompted and self-selected topics in practical, persuasive, descriptive, narrative, and expository domains
- WA4 Develop personal voice in writing
- WA5 Consider audience and purpose for writing
- WA6 Develop criteria for selection and potential development of topic
- WA7 Write in a journal or learning log to clarify personal thinking and knowledge
- WA8 Apply an expanding vocabulary gained through writing
- WA9 Make judicious use of reference sources (e.g., dictionary, thesaurus, online database, encyclopedia)
- WA10 Demonstrate an appreciation for aesthetically pleasing language through word choice and style
- WA11 Apply revising and editing strategies needed for writing task
- WA12 Vary sentence lengths and patterns
- WA13 Refine personal voice in writing
- WA14 Vary styles and formats for intended purpose and audience
- WA15 Apply criteria for selection and development of topic
- WA16 Participate in peer review of writing in progress
- WA17 Use transitions between sentences, ideas, and paragraphs in writing
- WA18 Revise and edit papers extensively in preparation for presentation/publication
- WA19 Develop a variety of genres (e.g, fantasy, science fiction, short stories, poetry)
- WA20 Focus writing and tone on such elements as audience, situation, and purpose
- WA21 Develop topic fully and appropriately
- WA22 Use writing process to clarify personal thinking and knowledge
- WA23 Apply appropriate recursive writing process as suggested by writing task and writer's process
- WA24 Develop an extended piece of writing (e.g., story, narrative poem, autobiography, novel, research paper)
- WA25 Revise writing and tone to assure focus on such elements as audience, situation, and purpose
- WA26 Use writing process to write reflectively

Subunit: Writing—Multidisciplinary

Competencies:

- WM1 Use writing process for learning across curriculum
- WM2 Use writing process to demonstrate knowledge of need for human rights and freedom
- WM3 Value and apply collaborative skills in the writing process
- WM4 Write in response to reading, speaking, viewing, and listening
- WM5 Use multidisciplinary resources in writing projects
- WM6 Use writing process to facilitate learning across curriculum
- WM7 Recognize value of and engage in collaboration in the writing process
- WM8 Use communication processes to develop a published writing piece in collaboration with others
- WM9 Record experiences and observations related to content learning
- WM10 Apply collaborative skills in the writing process
- WM11 Write collaboratively with peers
- WM12 Use cross-disciplinary resources in writing projects

Subunit: Listening/Visual Literacy—Structure

Competencies:

- LS1 Listen to and view a wide variety of genres (e.g, mystery, drama, poetry)
- LS2 Become aware of an author's style through listening to and viewing a variety of works

LS3 Recognize correct and appropriate grammar, diction, and syntax
LS4 Expand vocabulary through listening to and viewing varied media (e.g., recordings, films, music, news broadcasts)
LS5 Recognize beauty of language
LS6 Enhance recognition of an author's style through listening to and viewing a variety of works
LS7 Recognize use and misuse of language in media
LS8 Refine knowledge of style through listening to and viewing multiple works by the same author
LS9 Expand and refine grammar, diction, and syntax through listening
LS10 Compare authors' styles through viewing and listening to their works
LS11 Expand knowledge of complex grammar, diction, and syntax issues

Subunit: Listening/Visual Literacy—Meaning Construction

Competencies:

LM1 Develop critical thinking skills necessary to evaluate media and assess oral presentations
LM2 Compare new oral texts to past experiences and knowledge in order to enhance comprehension
LM3 Recognize how rhythmic patterns, silence, and cadences enhance quality of speech and literature
LM4 Focus listening and viewing on themes and/or plots
LM5 Gather information from listening and viewing experiences to enhance research
LM6 Use critical thinking skills to evaluate media and oral presentations
LM7 Use prior knowledge and experiences to facilitate comprehension of new oral texts
LM8 Identify rhythmic and time patterns in speech and literature
LM9 Identify and analyze themes and/or plots when listening and viewing
LM10 Use information gathered from listening and viewing experiences to expand research
LM11 Enhance use of critical thinking skills to evaluate media and oral presentations
LM12 Consider prior knowledge and experiences when attempting to understand the meaning of new texts
LM13 Appreciate rhythmic and time patterns of speech and literature
LM14 Select viewing and listening materials to support written text
LM15 Evaluate media and oral presentations analytically and critically
LM16 Organize prior knowledge and experiences to comprehend new texts
LM17 Organize and use viewing and listening materials to support written text

Subunit: Listening/Visual Literacy—Application

Competencies:

LA1 Listen attentively during oral reading
LA2 Use media as stimuli for learning and thinking
LA3 Develop knowledge of structure through art, music, and literature
LA4 Use electronic media to enhance and highlight language learning
LA5 Listen and view for entertainment and enjoyment
LA6 Use technology and other media (e.g., videos, posters, maps, graphs, t-shirts) as means of expressing ideas

Subunit: Listening/Visual Literacy—Multidisciplinary

Competencies:

LM1 Facilitate learning across curriculum through critical listening and viewing
LM2 Engage in individual, small-group, and whole-group listening and viewing activities
LM3 Develop language arts (e.g., viewing, listening) projects collaboratively
LM4 Investigate language and cultural differences through listening and viewing activities
LM5 Participate in a community of learners through productive listening

Subunit: Oral Communication—Structure

Competencies:

- OS1 Refine oral communication skills (e.g., voice modulation, eye contact, body language)
- OS2 Demonstrate knowledge of grammar, usage, and syntax when presenting
- OS3 Select topics and vocabulary suitable to audience
- OS4 Organize notes and ideas for speaking (e.g., cause-effect, chronological, exemplification)
- OS5 Use language imaginatively (e.g., word games, puns, limericks)
- OS6 Modulate voice to enhance meaning when interpreting literature orally
- OS7 Organize notes and ideas for formal, semiformal, and informal presentations of information
- OS8 Refine speaking techniques for formal, semiformal, and informal settings
- OS9 Develop repertoire of organizational strategies for presenting information orally
- OS10 Expand vocabulary to fit topic
- OS11 Select topics suitable to audience, situation, and purpose
- OS12 Select appropriate strategies when organizing notes and ideas for speaking

Subunit: Oral Communications—Meaning Construction

Competencies:

- OM1 Make connections between prior knowledge and new information for oral presentations
- OM2 Participate in informal speaking activities (e.g., offering opinions, supporting statements, questions, clarification, entertainment)
- OM3 Use interviewing techniques to gather information
- OM4 Communicate orally to entertain and to inform
- OM5 Participate in group communication activities (e.g., debates, panel discussions, negotiations, book-sharing, roundtables, cooperative/collaborative groups)
- OM6 Take and organize notes when preparing speech/presentation
- OM7 Interpret texts orally to illustrate meaning
- OM8 Respond to needs of various audiences
- OM9 Gather and assess information for speaking
- OM10 Communicate orally to inform and persuade
- OM11 Prepare and deliver formal speech/presentation
- OM12 Participate in a variety of oral interpretations
- OM13 Assess needs of audience, and adjust language and presentation according to their knowledge
- OM14 Analyze and synthesize information for speaking
- OM15 Describe effectiveness of a literary selection
- OM16 Describe topic or idea in order to clarify personal/audience thinking
- OM17 Analyze and synthesize information gathered from a variety of sources (e.g., interviews, hypermedia, reference works) for speaking
- OM18 Describe validity and/or quality of a literary selection and justify selection
- OM19 Interpret orally a variety of literature
- OM20 Describe topic or idea to clarify meaning for others

Subunit: Oral Communication—Application

Competencies:

- OA1 Become proficient at using interviewing techniques
- OA2 Give an oral interpretation for a specific audience
- OA3 Develop and apply oral communication skills for cooperative/collaborative learning
- OA4 Use oral communication for a variety of purposes and audiences (e.g., negotiations, book reviews, rationales)
- OA5 Develop and apply decision-making strategies
- OA6 Practice interviewing techniques
- OA7 Apply interviewing techniques to purposeful interviews
- OA8 Focus oral interpretation on a specific audience

Subunit: Oral Communications—Multidisciplinary

Competencies:

- OM1 Value thinking and language of others
- OM2 Develop oral projects collaboratively
- OM3 Be involved in individual, small-group, and whole-group language activities
- OM4 Participate actively in a community of learners
- OM5 Investigate language and cultural differences through oral language activities

Unit: Mathematics Skills

Subunit: Numbers and Number Relations

Competencies:

- NR1 Compare, order, and determine equivalence of real numbers
- NR2 Estimate answers, compute, and solve problems involving real numbers
- NR3 Compare and contrast real number system, rational number system, and whole number system
- NR4 Extend knowledge to complex number system, and develop facility with its operation

Subunit: Measurement

Competencies:

- M1 Estimate and use measurements
- M2 Understand the need for measurement and the probability that any measurement is accurate to some designated specification
- M3 Understand and apply measurements related to power and work
- M4 Understand and apply measurement concepts of distance-rate-time problems and acceleration problems with real-world experiments
- M5 Use real experiments to investigate elasticity, heat, sound, electricity, magnetism, light, acceleration, velocity, energy, and gravity
- M6 Use real-world problem situations involving mass and weight
- M7 Use real-world problem situations involving simple harmonic motion
- M8 Establish ratios with and without common units
- M9 Construct and interpret maps, tables, charts, and graphs as they relate to real-world mathematics
- M10 Understand and solve rate-change problems
- M11 Understand and solve right triangle relationships as they relate to measurement—specifically those that deal with the Pythagorean theorem
- M12 Graph and interpret ordered pairs
- M13 Compute total sales from a variety of items
- M14 Comprehend and compute rates of growth or decay
- M15 Comprehend, compute, and interpret real problems involving annuities
- M16 Develop an ability to identify real problems and provide possible solutions
- M17 Express and apply different types of measurement scales
- M18 Determine area and volume

NOTE: The math subunit on problem solving was not included on this list since it should be a continuing thread throughout all instruction rather than a separate set of competencies.

Subunit: Estimation and Mental Computation

Competencies:

- E1 Use estimation to eliminate choices in multiple-choice tests
- E2 Use estimation to determine reasonableness of problem situations in a wide variety of applications
- E3 Estimate shape of graphs of various functions and algebraic expressions
- E4 Use mental computation when computer and calculator are inappropriate

Subunit: Data Analysis and Probability

Competencies:

- D1 Organize data into tables, charts, and graphs
- D2 Understand and apply measures of central tendency, variability, and correlation
- D3 Use curve fitting to predict from data
- D4 Use experimental or theoretical probability, as appropriate, to represent and solve problems involving uncertainty
- D5 Use computer simulations and random number generators to estimate probabilities
- D6 Test hypotheses using appropriate statistics
- D7 Read, interpret, and use tables, charts, and graphs to identify patterns, note trends, draw conclusions, and make predictions
- D8 Identify probabilities of events involving unbiased objects
- D9 Use sampling and recognize its role in statistical claims
- D10 Design a statistical experiment to study problem, conduct experiment, and interpret and communicate outcomes
- D11 Describe normal curve in general terms, and use its properties
- D12 Create and interpret discrete probability distributions
- D13 Understand concept of random variable
- D14 Apply concept of random variable to generate and interpret probability distributions, including binomial, uniform, normal, and chi square

Subunit: Algebra

Competencies:

- A1 Describe problem situations by using and relating numerical, symbolic, and graphical representations
- A2 Use language and notation of functions in symbolic and graphing settings
- A3 Recognize, relate, and use the equivalent ideas of zeros of a function, roots of an equation, and solution of an equation in terms of graphical and symbolic representations
- A4 Describe and use logic of equivalence in working with equations, inequalities, and functions
- A5 Develop graphical techniques of solution for problem situations involving functions
- A6 Explore and describe characterizing features of functions
- A7 Make arguments and proofs in algebraic settings
- A8 Factor difference of two squares
- A9 Determine slope, midpoint, and distance
- A10 Explore and combine rational functions
- A11 Explore factoring techniques
- A12 Solve quadratic equations by factoring and formula
- A13 Set up and solve linear equations
- A14 Solve systems of linear equations with two variables
- A15 Describe geometric situations and phenomena using variables, equations, and functions
- A16 Describe measures of central tendency, mean, median, mode, and variance algebraically and graphically
- A17 Represent inequalities on the number line and in the coordinate plane
- A18 Use coordinate arguments in making geometric proofs

A19 Symbolize transformations of figures and graphs
A20 Explore geometric basis for functions of trigonometry
A21 Graph linear functions
A22 Develop and use vectors to represent direction and magnitude, including operations
A23 Use polar and parametric equations to describe, graph, and solve problem situations
A24 Represent sequences and series as functions both algebraically and graphically
A25 Explore recursive functions and procedures using spreadsheets, other computer utilities, and notions appropriate to these problem situations
A26 Describe and solve algebraic situations with matrices
A27 Describe and use inverse relationship between functions, including exponential and logarithmic
A28 Analyze and describe errors (and their sources) that can be made when using computers and calculators to solve problems
A29 Decide whether problem situation is best solved using computer, calculator, paper and pencil, or mental arithmetic/estimation techniques
A30 Explore relationships between complex numbers and vectors
A31 Make arguments concerning limits, convergence and divergence in contexts involving sequences, series, and other types of functions
A32 Represent transformations in the plane with matrices
A33 Contrast and compare algebras of rational, real, and complex numbers with characteristics of a matrix algebra system
A34 Construct polynomial approximations of a function over specified intervals of convergence
A35 Examine complex numbers as zeros of functions
A36 Translate verbal statements into symbolic language
A37 Simplify algebraic expressions
A38 Use laws and exponents (including scientific notation)
A39 Expand and extend idea of vectors and linear algebra to higher dimensional situations
A40 Use the idea of independent basis elements for a vector space and associated fundamental concepts of finite dimensional linear algebra
A41 Develop and communicate arguments about limit situations
A42 Use matrices to describe and apply transformations
A43 Develop and use polar and parametric equations to represent problem situations
A44 Explore proofs by mathematical induction

Subunit: Geometry

Competencies:

G1 Create and interpret drawings of three-dimensional objects
G2 Represent problem situations with geometric models and apply properties of figures
G3 Apply Pythagorean theorem
G4 Demonstrate knowledge of angles and parallel and perpendicular lines
G5 Explore inductive and deductive reasoning through applications to various subject areas
G6 Translate between synthetic and coordinate representations
G7 Identify congruent and similar figures using transformation with computer programs
G8 Deduce properties of figures using transformations and coordinates
G9 Use deductive reasoning
G10 Explore compass and straightedge constructions in context of geometric theorems
G11 Demonstrate knowledge of and ability to use proof
G12 Use variety of proof techniques (e.g., synthetic, transformational, and coordinate)
G13 Use variety of proof formats, including T-proof (i.e., two-column) and paragraph proof
G14 Explore different proof strategies
G15 Investigate different proofs of theorems
G16 Develop knowledge of an axiomatic system
G17 Apply transformations and coordinates in problem solving
G18 Represent problem situations with geometric models, and apply properties of figures

G19 Deduce properties of figures using vectors
G20 Analyze properties of Euclidean transformations, and relate translations to vectors
G21 Apply vectors in problem solving
G22 Develop further knowledge of axiomatic systems by investigating and comparing various geometries

Subunit: Patterns, Relations, and Functions

Competencies:

P1 Model real-world phenomena with polynomial and exponential functions
P2 Explore relationship between zeros and intercepts of functions
P3 Translate among tables, algebraic expressions, and graphs of functions
P4 Use graphing calculator or computer to generate graph of a function
P5 Explore relationship between a linear function and its inverse
P6 Describe and use characteristics of polynomial functions in problem-solving situations
P7 Explore conic sections, and graph using graphing calculator or computer
P8 Apply trigonometric functions to problem situations involving triangles
P9 Discover general relationships between algebraic description of conic, kind of conic, and special properties of that conic
P10 Explore periodic real-world phenomena using sine and cosine functions
P11 Analyze effects of parameter changes on graphs
P12 Use graphing calculator or computer to graph functions
P13 Develop a knowledge of rational and transcendental functions
P14 Understand connections between trigonometric and circular functions
P15 Use circular functions to model periodic real-world functions
P16 Solve trigonometric equations, and verify trigonometric identities
P17 Understand connections between trigonometric functions and polar coordinates, exponential functions , logarithmic functions, complex numbers, and series
P18 Model real-world phenomena with a variety of functions
P19 Graph using polar coordinates
P20 Explore graphs in three dimensions
P21 Explore functions of several variables
P22 Explore recursive functions using spreadsheets and/or programming languages

Unit: Science Skills

Subunit: Scientific Inquiry

Competencies:

Q1 Check the appropriateness and accuracy of measures and computations using various strategies (e.g., estimations, unit analysis, determination of significant figures)
Q2 Use ratios, proportions, and probabilities in appropriate problem situations
Q3 Translate information from and represent information in various forms with equal ease (e.g., tables, charts, graphs, diagrams, geometric figures)
Q4 Use existing algebraic formulas and create new ones in appropriate problem-solving situations
Q5 Estimate and justify probabilities of outcomes of familiar situations based on experimentation and other strategies
Q6 Invent apparatus and mechanical tools needed to perform unique tasks in various situations
Q7 Identify, compare, and contrast different modes of inquiry, habits of mind, and attitudes and dispositions
Q8 Design investigations that are safe and ethical (i.e., obtain consent and inform others of potential outcomes, risks, and benefits; and show evidence of concern for the health and safety of humans and non-human species)

Q9 Make and read scale drawings, maps, models, and other representations to aid planning and understanding
Q10 Seek elaboration and justification of data and ideas, and reflect on alternative interpretations of the information
Q11 Use appropriate units for counts and measures
Q12 Create and use databases (electronic and other) to collect, organize, and verify data and observations
Q13 Design and conduct investigations with multiple variables
Q14 Communicate the results of investigations clearly in a variety of situations
Q15 Examine relationships in nature, offer alternative explanations for the observations, and collect evidence that can be used to help judge among explanations
Q16 Trace the development (e.g., history, controversy, and ramifications) of various theories, focusing on supporting evidence and modification with new evidence
Q17 Select, invent, and use tools, including analog and digital instruments, to make and record direct measurements
Q18 Observe and document events and characteristics of complex systems
Q19 Explain the influence of perspective (e.g., spatial, temporal, and social) on observation and subsequent interpretations
Q20 Create multiple representations of the same data using a variety of symbols, descriptive languages, mathematical concepts, and graphic techniques
Q21 Generate testable hypotheses for observations of complex systems and interactions
Q22 Document potentially hazardous conditions and associated risks in selected homes and public areas
Q23 Participate in public debates, relying on documented and verified data to construct and represent a position on scientific issues
Q24 Construct and test models of physical, biological, social, and geological systems
Q25 Read, verify, debate, and, where necessary, refute research published in popular or technical journals of science (e.g., *Discover, Omni, Popular Mechanics*)
Q26 Explore discrepant events and develop and test explanations of what was observed
Q27 Conduct theory-based research using surveys, observational instruments, and other methods
Q28 Modify personal opinions, interpretations, explanations, and conclusions based on new information
Q29 Analyze error and develop explanations in various domains
Q30 Formulate taxonomic schemes based upon multivariate models that help to explain similarities and differences in form, distribution, behavior, survival, and origin of objects and organisms
Q31 Demonstrate various logical connections between related concepts (e.g., entropy, conservation of energy)
Q32 Account for discrepancies between theories and observations
Q33 Analyze the changes within a system when inputs, outputs, and interactions are altered
Q34 Create, standardize, and document procedures
Q35 Determine the sources of significant disparities between the predicted and recorded results, and change research procedures to minimize disparities
Q36 Research, locate, and propose applications for abstract patterns (e.g., fractals, Fibonacci sequences, string theory, orbitals)
Q37 Recognize and utilize classification systems for particles, elements, compounds, phenomena, organisms, and others for exploring and predicting properties and behaviors
Q38 Suggest and defend alternative experimental designs and data explanations (e.g., sampling, controls, safeguards)
Q39 Recognize and communicate differences between questions that can be investigated in a scientific way and those that rely on other ways of knowing
Q40 Draw conclusions based on the relationships among data analysis, experimental design, and possible models and theories
Q41 Suggest new questions as a result of reflection on and discussions about own scientific investigations
Q42 Investigate, assess, and comment on strengths and weakness of the descriptive and predictive powers of science
Q43 Create new information from representations of data in a variety of forms (e.g., symbols, descriptive languages, graphic formats) utilizing a variety of techniques (e.g., interpolations, extrapolations, linear regressions, central tendencies, correlations)

Subunit: Scientific Knowledge

Competencies:

- K1 Investigate various types of dynamic equilibrium (e.g., biological, geological, mechanical, chemical)
- K2 Investigate the relationship between the rates of energy exchange and the relative energy level of components within systems (e.g., trophic levels of ecosystems, osmosis, rate of heating and cooling, storms)
- K3 Investigate patterns in the natural world (e.g., heredity, crystalline structures, population and resource distributions, diffraction, dispersion, polarization)
- K4 Investigate models and theories that help to explain the interactions of components in systems (e.g., conservation of mass, energy, and momentum; foodwebs; natural selection; entropy; plate tectonics; chaos; relativity; social-psychology)
- K5 Investigate degrees of kinship among organisms and groups of organisms
- K6 Investigate the limits of the definition of life, and investigate organisms and physical systems that exist at or near these limits (e.g. viruses, quarks, black holes)
- K7 Investigate estimates and measurements of a wide range of distances and rates of change
- K8 Investigate the historical development of theories of change over time (e.g., natural selection, continental drift, the big bang, geologic change)
- K9 Investigate physical and chemical changes in living and nonliving systems (e.g., photosynthesis, weathering processes, glaciation, thermal effects of materials, energy cells)
- K10 Investigate simulations of nuclear change (e.g., radioactivity, half life, carbon dating)
- K11 Investigate conservation principles associated with physical, chemical, and nuclear changes
- K12 Formulate descriptions of the impacts of various forms of mechanical and electromagnetic waves on various organisms and objects
- K13 Formulate models and hypotheses for patterns in the natural world (e.g., earth structures, transportation systems, migrations, communications, constellations)
- K14 Formulate explanations for the influences of objects and organisms on each other over time
- K15 Formulate and interpret explanations for change phenomena (e.g., mass extinctions, stellar evolution, punctuated equilibrium, molecular synthesis)
- K16 Formulate and interpret explanations for the magnitudes of diversity at different periods of geologic time (e.g., mutation, global cataclysms, continental drift, competition, mass extinctions)
- K17 Formulate interpretations of the structure, function, and diversity in a variety of organisms and physical systems (e.g., DNA and RNA variants, nucleons, interaction particles)
- K18 Formulate understandings of geologic time (e.g., millennia, periods, epochs)
- K19 Formulate an understanding of the historical development of the model of the universe (e.g., Aristotle, Ptolemy, Copernicus, Brahe, Kepler, Galileo, Newton, Einstein)
- K20 Formulate explanations and representations of the production, transmission, and conservation of energy in biological and physical systems (e.g., weather, volcanism, earthquakes, electricity, magnetism, cellular respiration)
- K21 Formulate models and hypotheses about patterns in the natural world (e.g., social behavior, molecular structure, energy transformation, entropy, randomness, aging, chaos, hormonal cycles)
- K22 Formulate interpretations of the relationship between energy exchange and the interfaces between components within systems
- K23a Formulate estimations for the range of energies within and between various phenomena (e.g., thermal, electromagnetic, thermonuclear, chemical, electrical)
- K23b Formulate explanations for the historical development of descriptions of motions interactions and transformations of matter and energy (e.g., classical Newtonian mechanics, special and general relativity, chaos)
- K24 Formulate models that can be used to describe fundamental molecular interactions in living and non-living systems (e.g., cell membranes, semiconductors).
- K25 Formulate an understanding of the degree of relationship among organisms and objects based on molecular structure (e.g., proteins, nucleic acids)
- K26 Formulate hypotheses and models that may account for observable events (e.g., electricity and magnetism, gravitation, atoms, bonding, chemical reactions, quantum effects, energy flow on biological systems, predator-prey relationships)

K27 Formulate models and hypotheses about change over time (e.g., natural selection, speciation, punctuated equilibrium, phyleytic gradualism, stellar evolution, plate tectonics, radioactive decay, quantum mechanical theory)

K28 Formulate lists of limitations, and propose refinements of standard classification systems (e.g., periodic table, IUPAC, Linnean, standard model)

K29 Formulate specific cases of limitations and possible exceptions of theories and principles regarding the interactions of moving objects and organisms (e.g., fluid flow in vessels, motion near the speed of light, Heisenberg uncertainty principle, meteorological prediction, local variation and diversity, earthquake prediction, energy transport in cellular respiration)

K30 Formulate plans and contingencies that can be used to accommodate for changes to and stresses on systems (e.g., wildlife and habitat management, corrosion prevention, noise abatement, structure design)

K31 Formulate models of molecular, atomic, ionic, and subatomic structures and the physical and biological implications of these structures (e.g., genes, nucleons, quarks)

K32 Formulate estimates for a wide range of measurements and scales (e.g., angstroms to light years)

K33 Formulate and interpret representations of time from origin to present accounting for phenomena of scale (e.g., smoothness, punctuations, chaos)

K34 Formulate interpretations of the historical development of various theories of possible causes of diversity among physical and biological phenomena (e.g., the works of Aristotle, Mendel, Darwin, McClintock)

K35 Formulate models and hypotheses that can be used to explain the interactions of components within technological and ecological systems

Subunit: Conditions for Learning Science

Competencies:

C1 Participate actively in dialogue about and resolution of community issues

C2 Assess information from various countries in the original language or translated form to ascertain the perspectives of many cultures

C3 Analyze the scientific ideas presented in science fiction stories and films

C4 Perform and repeat investigations to verify data, determine regularity, and reduce the impact of experimental error

C5 Present the results of investigations in a variety of forums

C6 Contribute to the decisions regarding topics for investigation

C7 Use various creative means to communicate interpretations of scientific ideas, concepts, phenomena, and events

C8 Consider the scientific thinking and language of others

C9 Individually and collaboratively produce clearly written representations of investigative results

C10 Fulfill responsibilities as part of a research group

C11 Select and utilize resources by various criteria (e.g., efficiency, effectiveness, health, safety) that are appropriate to the investigations being conducted by groups

C12 Present persuasive argument based on the scientific aspects of controversial issues

C13 Collect, store, retrieve, and manipulate information with available technologies that may range from hand processes up through computer applications

C14 Investigate social issues with a scientific perspective (e.g., human rights, wellness, economics, futurism, environmental ethics)

C15 Keep journals of observations and inferences made over an extended period of time, and reflect upon the impact of these recorded ideas on own thinking and actions

C16 Examine the intellect, perspectives, and ethics of notable scientists

C17 Collect and analyze observations made over extended periods of time and compare these to scientific theories

C18 Create presentations of scientific understandings using diverse modes of expressions

C19 Conduct formal scientific debates in the classroom

C20 Wonder about the likelihood of events that may occur by chance or coincidence
C21 Plan and conduct field trips and experiences for small and large groups
C22 Analyze the historical context that leads to and has led to scientific theories
C23 Seek information on topics of personal scientific interest from a variety of sources
C24 Conduct learner-developed investigations independently and collaboratively over periods of weeks and months
C25 Listen attentively and critically to presentations of scientific information made by others
C26 Conduct analyses of propaganda related to scientific issues
C27 Perform investigations that require observations over varying periods of time
C28 Experience scientific concepts as interpreted by other cultures through multimedia and local and global specialists
C29 Access appropriate technology to perform complicated, time-consuming tasks
C30 Relate historical accounts of science to the cultural context in which they were written
C31 Work as a contributing member of a collaborative research group
C32 Examine the influences of social and political structures and realities that contribute to inquiry about scientific issues
C33 Use technology (e.g., desktop publishing, teleconferencing, networking) to communicate scientific ideas
C34 Explore and analyze a variety of perspectives on science (e.g., works by men and women of many racial, ethnic, and cultural groups)
C35 Lead groups of learners of various ages in designing, planning, and conducting science activities
C36 Respect the scientific thinking of others and self
C37 Recognize and contrast different epistemologies
C38 Develop possible courses of action in response to scientific issues of local and global concern
C39 Determine the validity of research conclusions in relation to the design, performance, and results
C40 Develop multimedia presentations of group and individual research projects and investigations appropriate for a variety of audiences and forums
C41 Produce interesting and scientifically correct stories and present them using various modes of expression
C42 Reflect on the ideas and content found in own journal records
C43 Examine ambiguous results and formulate explanations
C44 Recognize and synthesize the contributions to scientific thought of individuals from many cultures
C45 Construct models and simulations of the component structures and functions of living and nonliving entities
C46 Lead multi-age groups in the examination of and planned resolution for scientific issues
C47 Recognize and choose members of research teams based upon the merit of their ideas and skills
C48 Construct a portfolio of products, documentation, and self-evaluations of own abilities, skills, and experiences
C49 Synthesize scientific information from a variety of sources
C50 Evaluate and prioritize scientific issues based upon risk-benefit analyses
C51 Refine scientific skills from a variety of experiences

Subunit: Applications for Science Learning

Competencies:

A1 Answer student-determined questions by designing databases and drawing inferences from the analyses of the information in these databases
A2 Make personal behavior decisions by interpreting information that has a scientific basis
A3 Propose courses of action that will validate and demonstrate personal understandings of scientific principles
A4 Guide other learners in their understanding of the interactions of technologies and society at various periods in time
A5 Promote and carry out practices that contribute to a sustainable environment

A6 Study and propose improvements in public services and systems in own community
A7 Choose consumer materials utilizing personal and environmental risk and benefit information
A8 Make inferences and draw conclusions using databases, spreadsheets, and other technologies
A9 Do simple troubleshooting on common electrical and mechanical systems, identifying and eliminating possible causes of malfunctions
A10 Construct devices that perform simple, repetitive actions
A11 Investigate the functionality of various geometric shapes in the natural world and the designed world (e.g., translations from spherical to plane representations cause distortions; triangular shapes contribute to rigidity and stability in structures; round shapes minimize boundary for a given capacity)
A12 Make decisions regarding personal and public health
A13 Evaluate the social and ecological risks and benefits resulting from the use of various consumer products
A14 Analyze the contributions of advances in technology through history to own everyday life
A15 Identify and reduce risks and threats to a sustainable environment
A16 Extend the limits of human capabilities using technological enhancements
A17 Use and recognize various propaganda techniques
A18 Solve unique problems using the results of systematic analyses
A19 Choose everyday consumer products that utilize recent innovation and pass appropriate performance criteria
A20 Refine personal career interests through investigations of the diversity of manufacturing, research, service, and invention processes
A21 Predict and investigate the working of toys and tools while controlling and manipulating variables (e.g., friction, gravity, forces)
A22 Write, follow, modify, and extend instructions (e.g., equations, algorithms, formulas, flow diagrams, illustrations)
A23 Create products, make inferences, and draw conclusions using databases, spreadsheets, and other technologies
A24 Predict various scenarios and propose solutions to community issues using scientific information (e.g., actuarial tables, census data, topographic maps, incidence data, climatic data)
A25 Use scientific evidence to consider options and formulate positions about the health and safety of others and self
A26 Search for, use, create, and store objects and information using various strategies and methods of organization and access
A27 Research and write environmental impact statements of own design
A28 Compare school-based science perspectives with those gained through cutting-edge technological applications
A29 Design management plans for natural and human-altered environments (e.g., woodlots, patios, lots, lawns, farmlands, forests)
A30 Refine personal career interests
A31 Promote public awareness of the interaction of technology with social issues
A32 Advocate and propose courses of action for local and global scientific issues using global networks
A33 Use appropriate technologies to prepare and present the findings of investigations incorporating tables, graphs, diagrams, and text
A34 Make informed consumer choices by evaluating and prioritizing information, evidence, and strategies
A35 Develop an informed point of view that allows for validation or refutation of the scientific statements and claims of advocates before pursuing courses of action (e.g., contributing support, signing petitions, casting votes)
A36 Differentiate between observations and inferences in the exploration of evidence related to personal, scientific, and community issues
A37 Develop and write environmental impact, and safety and hygiene management plans
A38 Use technology to collect, analyze, and communicate information (e.g., electronic networks, desktop publishing, remote sensing, graphing calculators, satellite telemetry, and others)
A39 Design, construct, and market inventions

Academic Competencies: Horticulture

The Horticulture OCAP panel of expert workers (see member list on the inside back cover) identified the following academic competencies (from the total list, pp. 58-72) as most crucial to the entry-level success of an employee in the area of horticulture. It is recommended that these competencies be taught in an applied manner for students enrolled in horticulture programs.

Unit: Communications Skills

Subunit: Reading—Structure

Competencies:

RS1	Exhibit knowledge of language structure
RS2	Recognize that there may be more than one interpretation of reading selections
RS5	Develop and use an increasingly sophisticated vocabulary gained through context
RS6	Apply knowledge of language structure to reading
RS15	Apply an expanding vocabulary gained through reading
RS16	Explain various interpretations and levels of meaning in reading selections (e.g., symbolism, nuance)
RS19	Analyze and synthesize pieces of literature with regard to plot, dialogue, theme, setting, and characterization

Subunit: Reading—Meaning Construction

Competencies:

RM1	Demonstrate ability to recognize appropriate pre-reading strategies
RM2	Describe effectiveness of a reading selection
RM3	Read to clarify personal thinking and knowledge
RM4	Support interpretation of text by locating and citing specific information
RM5	Develop personal response to a variety of literary works
RM7	Engage in self-selected reading activities
RM8	Confirm and extend meaning in reading by researching new concepts and facts
RM9	Self-monitor and apply corrective strategies when communication has been interrupted or lost
RM10	Use features of literary genres to extend meaning
RM12	Use reading as a possible problem-solving strategy to clarify personal thinking and knowledge
RM17	Clarify meaning when reading, using knowledge of literary devices, stylistic diction, and other semantic elements
RM20	Use reference books to find, evaluate, and synthesize information

Subunit: Reading—Application

Competencies:

RA1	Select and read material for personal enjoyment and information
RA3	Employ various reading strategies (e.g., scanning, skimming, reviewing, questioning, testing, retaining) according to purpose
RA4	Participate in selection of books, materials, and topics for literature study groups
RA5	Develop and apply knowledge of the interrelationship of concepts (e.g., construction of webs, graphs, timelines)
RA6	Read selections from a variety of styles and formats, recognizing that style and format influence meaning
RA7	Extend value of reading, writing, speaking, viewing, and listening by pursuing, through reading, new concepts and interests developed as a result of these activities
RA8	Read extensively from the works of a particular author, and explain elements of author's style

Subunit: Reading—Multidisciplinary

Competencies:

RM2	Read to facilitate learning across curriculum
RM3	Read to develop awareness of human rights and freedom
RM4	Participate actively in a community of learners
RM6	Explore and analyze a variety of cultural elements, attitudes, beliefs, and value structures by reading and experiencing our diverse literary tradition, including works by men and women of many racial, ethnic, and cultural groups
RM7	Value thinking and language of others
RM9	Read to facilitate content learning

Subunit: Writing—Structure

Competencies:

WS1	Develop and expand a repertoire of organizational strategies (e.g., narration, comparison/contrast, and description) through practice and discussion
WS2	Clarify word choice according to audience, topic, and purpose
WS3	Locate and correct errors in usage, spelling, and mechanics (e.g., subject-verb agreement, parallel construction, pronoun reference, punctuation, capitalization, sentence structure) using a variety of resources
WS4	Recognize information gained from primary and secondary sources
WS5	Develop writing that contains ordered, related, well-developed paragraphs with sentences of varied lengths and patterns
WS6	Use information from a variety of sources to develop an integrated piece of writing
WS7	Evaluate and revise writing to focus on such things as audience, tone, and purpose
WS8	Recognize differences between documentation and reference list styles
WS9	Develop extended pieces of writing that contain ordered, related, well-developed paragraphs with sentences of varied lengths and patterns
WS10	Select from a repertoire of organization strategies a pattern appropriate to a topic (e.g., narration, example, detail, comparison/contrast, classification)
WS11	Synthesize information from a variety of sources to construct meaning

Continued

Subunit: Writing—Structure —Continued

WS12	Refine word choice and tone according to audience, situation, and purpose
WS13	Appropriately cite information gained from primary and secondary sources
WS14	Use style manuals or software to prepare documentation and reference lists
WS15	Develop effectively organized pieces of expository writing containing strong voice, clear thesis, and well-developed ideas
WS16	Identify organization patterns appropriate to writing topic
WS17	Respond to others' suggested revisions to a writing piece

Subunit: Writing—Meaning Construction

Competencies:

WM2	Develop criteria for writing evaluation using scoring guides (e.g., rubric/holistic scale, primary trait scoring) and peer/teacher assistance to clarify meaning
WM3	Respond to others' suggested revisions to a piece of writing (e.g., self-question, re-read, revise)
WM4	Use word processing, graphics, and publishing as aids for constructing meaning in writing
WM5	Engage in self-initiated writing activities
WM6	Incorporate personal criteria with generally accepted standards for writing evaluation
WM7	Evaluate, analyze, and synthesize information for writing
WM8	Evaluate own writing using personal and established scoring criteria
WM9	Assess personal/peer revisions to a writing piece
WM10	Recognize and refine personal writing styles

Subunit: Writing—Application

Competencies:

WA20	Focus writing and tone on such elements as audience, situation, and purpose
WA21	Develop topic fully and appropriately
WA22	Use writing process to clarify personal thinking and knowledge
WA24	Develop an extended piece of writing (e.g., story, narrative poem, autobiography, novel, research paper)
WA25	Revise writing and tone to assure focus on such elements as audience, situation, and purpose
WA26	Use writing process to write reflectively

Subunit: Writing—Multidisciplinary

Competencies:

WM1	Use writing process for learning across curriculum
WM3	Value and apply collaborative skills in the writing process
WM4	Write in response to reading, speaking, viewing, and listening
WM5	Use multidisciplinary resources in writing projects
WM6	Use writing process to facilitate learning across curriculum
WM9	Record experiences and observations related to content learning
WM11	Write collaboratively with peers
WM12	Use cross-disciplinary resources in writing projects

Subunit: Listening/Visual Literacy—Structure

Competencies:

LS1	Listen to and view a wide variety of genres (e.g., mystery, drama, poetry)
LS3	Recognize correct and appropriate grammar, diction, and syntax
LS4	Expand vocabulary through listening to and viewing varied media (e.g., recordings, films, music, news broadcasts)
LS5	Recognize beauty of language
LS9	Expand and refine grammar, diction, and syntax through listening
LS11	Expand knowledge of complex grammar, diction, and syntax issues

Subunit: Listening/Visual Literacy—Meaning Construction

Competencies:

LM1	Develop critical thinking skills necessary to evaluate media and assess oral presentations
LM2	Compare new oral texts to past experiences and knowledge in order to enhance comprehension
LM4	Focus listening and viewing on themes and/or plots
LM5	Gather information from listening and viewing experiences to enhance research
LM6	Use critical thinking skills to evaluate media and oral presentations
LM7	Use prior knowledge and experiences to facilitate comprehension of new oral texts
LM9	Identify and analyze themes and/or plots when listening and viewing
LM10	Use information gathered from listening and viewing experiences to expand research
LM11	Enhance use of critical thinking skills to evaluate media and oral presentations
LM12	Consider prior knowledge and experiences when attempting to understand the meaning of new texts
LM14	Select viewing and listening materials to support written text
LM15	Evaluate media and oral presentations analytically and critically
LM16	Organize prior knowledge and experiences to comprehend new texts
LM17	Organize and use viewing and listening materials to support written text

Subunit: Listening/Visual Literacy—Application

Competencies:

LA1	Listen attentively during oral reading
LA2	Use media as stimuli for learning and thinking
LA3	Develop knowledge of structure through art, music, and literature
LA4	Use electronic media to enhance and highlight language learning
LA5	Listen and view for entertainment and enjoyment
LA6	Use technology and other media (e.g., videos, posters, maps, graphs, t-shirts) as means of expressing ideas

Subunit: Listening/Visual Literacy—Multidisciplinary

Competencies:

LM1	Facilitate learning across curriculum through critical listening and viewing
LM2	Engage in individual, small-group, and whole-group listening and viewing activities
LM4	Investigate language and cultural differences through listening and viewing activities
LM5	Participate in a community of learners through productive listening

Subunit: Oral Communication—Structure

Competencies:

OS1	Refine oral communication skills (e.g., voice modulation, eye contact, body language)
OS2	Demonstrate knowledge of grammar, usage, and syntax when presenting
OS3	Select topics and vocabulary suitable to audience
OS4	Organize notes and ideas for speaking (e.g., cause-effect, chronological, exemplification)
OS5	Use language imaginatively (e.g., word games, puns, limericks)
OS6	Modulate voice to enhance meaning when interpreting literature orally
OS7	Organize notes and ideas for formal, semiformal, and informal presentations of information
OS8	Refine speaking techniques for formal, semiformal, and informal settings
OS10	Expand vocabulary to fit topic
OS11	Select topics suitable to audience, situation, and purpose
OS12	Select appropriate strategies when organizing notes and ideas for speaking

Subunit: Oral Communications—Meaning Construction

Competencies:

OM1	Make connections between prior knowledge and new information for oral presentations
OM2	Participate in informal speaking activities (e.g., offering opinions, supporting statements, questions, clarification, entertainment)
OM3	Use interviewing techniques to gather information
OM4	Communicate orally to entertain and to inform
OM5	Participate in group communication activities (e.g., debates, panel discussions, negotiations, book-sharing, roundtables, cooperative/collaborative groups)
OM6	Take and organize notes when preparing speech/presentation
OM7	Interpret texts orally to illustrate meaning
OM8	Respond to needs of various audiences
OM9	Gather and assess information for speaking
OM10	Communicate orally to inform and persuade
OM11	Prepare and deliver formal speech/presentation
OM12	Participate in a variety of oral interpretations
OM13	Assess needs of audience, and adjust language and presentation according to their knowledge
OM14	Analyze and synthesize information for speaking
OM15	Describe effectiveness of a literary selection
OM16	Describe topic or idea in order to clarify personal/audience thinking
OM17	Analyze and synthesize information gathered from a variety of sources (e.g., interviews, hypermedia, reference works) for speaking
OM20	Describe topic or idea to clarify meaning for others

Subunit: Oral Communication—Application

Competencies:

OA1	Become proficient at using interviewing techniques
OA2	Give an oral interpretation for a specific audience
OA3	Develop and apply oral communication skills for cooperative/collaborative learning
OA4	Use oral communication for a variety of purposes and audiences (e.g., negotiations, book reviews, rationales)
OA5	Develop and apply decision-making strategies
OA6	Practice interviewing techniques
OA7	Apply interviewing techniques to purposeful interviews
OA8	Focus oral interpretation on a specific audience

Subunit: Oral Communications—Multidisciplinary

Competencies:

OM1	Value thinking and language of others
OM2	Develop oral projects collaboratively
OM3	Be involved in individual, small-group, and whole-group language activities
OM4	Participate actively in a community of learners
OM5	Investigate language and cultural differences through oral language activities

Unit: Mathematics Skills

Subunit: Numbers and Number Relations

Competencies:

NR1	Compare, order, and determine equivalence of real numbers
NR2	Estimate answers, compute, and solve problems involving real numbers
NR3	Compare and contrast real number system, rational number system, and whole number system

Subunit: Measurement

Competencies:

M1	Estimate and use measurements
M2	Understand the need for measurement and the probability that any measurement is accurate to some designated specification
M3	Understand and apply measurements related to power and work
M4	Understand and apply measurement concepts of distance-rate-time problems and acceleration problems with real-world experiments
M5	Use real experiments to investigate elasticity, heat, sound, electricity, magnetism, light, acceleration, velocity, energy, and gravity
M6	Use real-world problem situations involving mass and weight
M8	Establish ratios with and without common units
M9	Construct and interpret maps, tables, charts, and graphs as they relate to real-world mathematics

Continued

Subunit: Measurement—Continued

M10	Understand and solve rate-change problems
M11	Understand and solve right triangle relationships as they relate to measurement—specifically those that deal with the Pythagorean theorem
M13	Compute total sales from a variety of items
M16	Develop an ability to identify real problems and provide possible solutions
M17	Express and apply different types of measurement scales
M18	Determine area and volume

Subunit: Estimation and Mental Computation

Competencies:

E2	Use estimation to determine reasonableness of problem situations in a wide variety of applications
E3	Estimate shape of graphs of various functions and algebraic expressions
E4	Use mental computation when computer and calculator are inappropriate

Subunit: Data Analysis and Probability

Competencies:

D1	Organize data into tables, charts, and graphs
D5	Use computer simulations and random number generators to estimate probabilities
D6	Test hypotheses using appropriate statistics
D7	Read, interpret, and use tables, charts, and graphs to identify patterns, note trends, draw conclusions, and make predictions

Subunit: Algebra

Competencies:

A1	Describe problem situations by using and relating numerical, symbolic, and graphical representations
A2	Use language and notation of functions in symbolic and graphing settings
A4	Describe and use logic of equivalence in working with equations, inequalities, and functions
A8	Factor difference of two squares
A9	Determine slope, midpoint, and distance
A15	Describe geometric situations and phenomena using variables, equations, and functions
A18	Use coordinate arguments in making geometric proofs
A20	Explore geometric basis for functions of trigonometry
A25	Explore recursive functions and procedures using spreadsheets, other computer utilities, and notions appropriate to these problem situations
A28	Analyze and describe errors (and their sources) that can be made when using computers and calculators to solve problems
A29	Decide whether problem situation is best solved using computer, calculator, paper and pencil, or mental arithmetic/estimation techniques
A36	Translate verbal statements into symbolic language
A37	Simplify algebraic expressions

Subunit: Geometry

Competencies:

G1	Create and interpret drawings of three-dimensional objects
G2	Represent problem situations with geometric models and apply properties of figures
G3	Apply Pythagorean theorem
G4	Demonstrate knowledge of angles and parallel and perpendicular lines
G9	Use deductive reasoning
G10	Explore compass and straightedge constructions in context of geometric theorems

Subunit: Patterns, Relations, and Functions

Competencies:

P3	Translate among tables, algebraic expressions, and graphs of functions
P4	Use graphing calculator or computer to generate graph of a function
P12	Use graphing calculator or computer to graph functions

Unit: Science Skills

Subunit: Scientific Inquiry

Competencies:

Q1	Check the appropriateness and accuracy of measures and computations using various strategies (e.g., estimations, unit analysis, determination of significant figures)
Q2	Use ratios, proportions, and probabilities in appropriate problem situations
Q3	Translate information from and represent information in various forms with equal ease (e.g., tables, charts, graphs, diagrams, geometric figures)
Q5	Estimate and justify probabilities of outcomes of familiar situations based on experimentation and other strategies
Q7	Identify, compare, and contrast different modes of inquiry, habits of mind, and attitudes and dispositions
Q9	Make and read scale drawings, maps, models, and other representations to aid planning and understanding
Q10	Seek elaboration and justification of data and ideas, and reflect on alternative interpretations of the information
Q11	Use appropriate units for counts and measures
Q12	Create and use databases (electronic and other) to collect, organize, and verify data and observations
Q13	Design and conduct investigations with multiple variables
Q14	Communicate the results of investigations clearly in a variety of situations
Q15	Examine relationships in nature, offer alternative explanations for the observations, and collect evidence that can be used to help judge among explanations
Q17	Select, invent, and use tools, including analog and digital instruments, to make and record direct measurements
Q20	Create multiple representations of the same data using a variety of symbols, descriptive languages, mathematical concepts, and graphic techniques

Continued

Subunit: Scientific Inquiry—Continued

Q22	Document potentially hazardous conditions and associated risks in selected homes and public areas
Q23	Participate in public debates, relying on documented and verified data to construct and represent a position on scientific issues
Q24	Construct and test models of physical, biological, social, and geological systems
Q25	Read, verify, debate, and, where necessary, refute research published in popular or technical journals of science (e.g., Discover, Omni, Popular Mechanics)
Q26	Explore discrepant events and develop and test explanations of what was observed
Q27	Conduct theory-based research using surveys, observational instruments, and other methods
Q28	Modify personal opinions, interpretations, explanations, and conclusions based on new information
Q29	Analyze error and develop explanations in various domains
Q30	Formulate taxonomic schemes based upon multivariate models that help to explain similarities and differences in form, distribution, behavior, survival, and origin of objects and organisms
Q32	Account for discrepancies between theories and observations
Q34	Create, standardize, and document procedures
Q39	Recognize and communicate differences between questions that can be investigated in a scientific way and those that rely on other ways of knowing
Q40	Draw conclusions based on the relationships among data analysis, experimental design, and possible models and theories
Q41	Suggest new questions as a result of reflection on and discussions about own scientific investigations
Q42	Investigate, assess, and comment on strengths and weakness of the descriptive and predictive powers of science

Subunit: Scientific Knowledge

Competencies:

K1	Investigate various types of dynamic equilibrium (e.g., biological, geological, mechanical, chemical)
K2	Investigate the relationship between the rates of energy exchange and the relative energy level of components within systems (e.g., trophic levels of ecosystems, osmosis, rate of heating and cooling, storms)
K4	Investigate models and theories that help to explain the interactions of components in systems (e.g., conservation of mass, energy, and momentum; foodwebs; natural selection; entropy; plate tectonics; chaos; relativity; social-psychology)
K5	Investigate degrees of kinship among organisms and groups of organisms
K9	Investigate physical and chemical changes in living and nonliving systems (e.g., photosynthesis, weathering processes, glaciation, thermal effects of materials, energy cells)
K11	Investigate conservation principles associated with physical, chemical, and nuclear changes
K14	Formulate explanations for the influences of objects and organisms on each other over time
K17	Formulate interpretations of the structure, function, and diversity in a variety of organisms and physical systems (e.g., DNA and RNA variants, nucleons, interaction particles)
K20	Formulate explanations and representations of the production, transmission, and conservation of energy in biological and physical systems (e.g., weather, volcanism, earth quakes, electricity, magnetism, cellular respiration)

Continued

Subunit: Scientific Knowledge—Continued

K24	Formulate models that can be used to describe fundamental molecular interactions in living and non-living systems (e.g., cell membranes, semiconductors).
K29	Formulate specific cases of limitations and possible exceptions of theories and principles regarding the interactions of moving objects and organisms (e.g., fluid flow in vessels, motion near the speed of light, Heisenberg uncertainty principle, meteorological prediction, local variation and diversity, earthquake prediction, energy transport in cellular respiration)
K30	Formulate plans and contingencies that can be used to accommodate for changes to and stresses on systems (e.g., wildlife and habitat management, corrosion prevention, noise abatement, structure design)
K34	Formulate interpretations of the historical development of various theories of possible causes of diversity among physical and biological phenomena (e.g., the works of Aristotle, Mendel, Darwin, McClintock)
K35	Formulate models and hypotheses that can be used to explain the interactions of components within technological and ecological systems

Subunit: Conditions for Learning Science

Competencies:

C1	Participate actively in dialogue about and resolution of community issues
C7	Use various creative means to communicate interpretations of scientific ideas, concepts, phenomena, and events
C8	Consider the scientific thinking and language of others
C9	Individually and collaboratively produce clearly written representations of investigative results
C10	Fulfill responsibilities as part of a research group
C11	Select and utilize resources by various criteria (e.g., efficiency, effectiveness, health, safety) that are appropriate to the investigations being conducted by groups
C12	Present persuasive argument based on the scientific aspects of controversial issues
C13	Collect, store, retrieve, and manipulate information with available technologies that may range from hand processes up through computer applications
C14	Investigate social issues with a scientific perspective (e.g., human rights, wellness, economics, futurism, environmental ethics)
C15	Keep journals of observations and inferences made over an extended period of time, and reflect upon the impact of these recorded ideas on own thinking and actions
C17	Collect and analyze observations made over extended periods of time and compare these to scientific theories
C20	Wonder about the likelihood of events that may occur by chance or coincidence
C23	Seek information on topics of personal scientific interest from a variety of sources
C25	Listen attentively and critically to presentations of scientific information made by others
C26	Conduct analyses of propaganda related to scientific issues
C27	Perform investigations that require observations over varying periods of time
C31	Work as a contributing member of a collaborative research group
C33	Use technology (e.g., desktop publishing, teleconferencing, networking) to communicate scientific ideas
C36	Respect the scientific thinking of others and self
C38	Develop possible courses of action in response to scientific issues of local and global concern

Continued

Subunit: Conditions for Learning Science—Continued

C39	Determine the validity of research conclusions in relation to the design, performance, and results
C45	Construct models and simulations of the component structures and functions of living and nonliving entities
C49	Synthesize scientific information from a variety of sources
C51	Refine scientific skills from a variety of experiences

Subunit: Applications for Science Learning

Competencies:

A2	Make personal behavior decisions by interpreting information that has a scientific basis
A3	Propose courses of action that will validate and demonstrate personal understandings of scientific principles
A4	Guide other learners in their understanding of the interactions of technologies and society at various periods in time
A5	Promote and carry out practices that contribute to a sustainable environment
A6	Study and propose improvements in public services and systems in own community
A8	Make inferences and draw conclusions using databases, spreadsheets, and other technologies
A9	Do simple troubleshooting on common electrical and mechanical systems, identifying and eliminating possible causes of malfunctions
A11	Investigate the functionality of various geometric shapes in the natural world and the designed world (e.g., translations from spherical to plane representations cause distortions; triangular shapes contribute to rigidity and stability in structures; round shapes minimize boundary for a given capacity)
A12	Make decisions regarding personal and public health
A13	Evaluate the social and ecological risks and benefits resulting from the use of various consumer products
A14	Analyze the contributions of advances in technology through history to own everyday life
A15	Identify and reduce risks and threats to a sustainable environment
A17	Use and recognize various propaganda techniques
A19	Choose everyday consumer products that utilize recent innovation and pass appropriate performance criteria
A24	Predict various scenarios and propose solutions to community issues using scientific information (e.g., actuarial tables, census data, topographic maps, incidence data, climatic data)
A25	Use scientific evidence to consider options and formulate positions about the health and safety of others and self
A27	Research and write environmental impact statements of own design
A29	Design management plans for natural and human-altered environments (e.g., woodlots, patios, lots, lawns, farmlands, forests)
A30	Refine personal career interests
A31	Promote public awareness of the interaction of technology with social issues
A35	Develop an informed point of view that allows for validation or refutation of the scientific statements and claims of advocates before pursuing courses of action (e.g., contributing support, signing petitions, casting votes)
A37	Develop and write environmental impact, and safety and hygiene management plans
A39	Design, construct, and market inventions

Notes

Verification Panels

The Vocational Instructional Materials Laboratory wishes to extend thanks and appreciation to the many representatives of business, industry, labor, and community organizations who donated their time and expertise to the identification and revalidation of competencies.

The following panel was responsible for verifying the occupational competencies on the Horticulture OCAP, identifying those academic competencies that an entry-level employee should possess, and determining the Work Keys academic skill levels required for successful entry into the occupation:

James David Bliek, *Flowers by Davids Square*, Columbus, Ohio
Shannon Bower, *College of Wooster*, Wooster, Ohio
William D. Brown, *Medallion Golf Course*, Westerville, Ohio
Nick S. Gani, *Avery Road Gardens*, Amlin, Ohio
David L. Hale, *Flowers by Davids Square*, Columbus, Ohio
Raymond S. Hodgson, *Hills' Floral Group*, Cleveland, Ohio
David A. Liddle, *Hills' Floral Group*, Cleveland, Ohio
Sam McCracken, *Cleveland Botanical Garden*, Cleveland, Ohio

The following panel was responsible for verifying the competencies on the Employability OCAP:

Barbara J. Forster, *Nationwide Insurance*, Columbus, Ohio
Joan L. Hall, *Health Management Nursing*, Chesapeake, Ohio
Jane Highland, *Southern Ohio Staffing, Inc.*, Chillicothe, Ohio
Chuck Jackson, *Butech, Inc.*, Salem, Ohio
Garry Kessel, *Medina Auto Parts, Inc.*, Medina, Ohio
Joyce A. McMickens, *Ernst & Young*, Cleveland, Ohio
Julie C. Payeff, *The Andersons Management Corp.*, Maumee, Ohio
Patricia Piper, *Edison Industrial Systems Center*, Toledo, Ohio
Gary F. Rybak, *Red Roof Inns, Inc.*, Hilliard, Ohio